This is a digital copy of a book that was preserved for generations on library shelves before it was carefully scanned by Google as part of a project to make the world's books discoverable online.

It has survived long enough for the copyright to expire and the book to enter the public domain. A public domain book is one that was never subject to copyright or whose legal copyright term has expired. Whether a book is in the public domain may vary country to country. Public domain books are our gateways to the past, representing a wealth of history, culture and knowledge that's often difficult to discover.

Marks, notations and other marginalia present in the original volume will appear in this file - a reminder of this book's long journey from the publisher to a library and finally to you.

Usage guidelines

Google is proud to partner with libraries to digitize public domain materials and make them widely accessible. Public domain books belong to the public and we are merely their custodians. Nevertheless, this work is expensive, so in order to keep providing this resource, we have taken steps to prevent abuse by commercial parties, including placing technical restrictions on automated querying.

We also ask that you:

+ *Make non-commercial use of the files* We designed Google Book Search for use by individuals, and we request that you use these files for personal, non-commercial purposes.

+ *Refrain from automated querying* Do not send automated queries of any sort to Google's system: If you are conducting research on machine translation, optical character recognition or other areas where access to a large amount of text is helpful, please contact us. We encourage the use of public domain materials for these purposes and may be able to help.

+ *Maintain attribution* The Google "watermark" you see on each file is essential for informing people about this project and helping them find additional materials through Google Book Search. Please do not remove it.

+ *Keep it legal* Whatever your use, remember that you are responsible for ensuring that what you are doing is legal. Do not assume that just because we believe a book is in the public domain for users in the United States, that the work is also in the public domain for users in other countries. Whether a book is still in copyright varies from country to country, and we can't offer guidance on whether any specific use of any specific book is allowed. Please do not assume that a book's appearance in Google Book Search means it can be used in any manner anywhere in the world. Copyright infringement liability can be quite severe.

About Google Book Search

Google's mission is to organize the world's information and to make it universally accessible and useful. Google Book Search helps readers discover the world's books while helping authors and publishers reach new audiences. You can search through the full text of this book on the web at `http://books.google.com/`

APPENDIX TO THE JOURNALS

OF THE

SENATE AND ASSEMBLY

OF THE

TWENTY-NINTH SESSION

OF THE

LEGISLATURE OF THE STATE OF CALIFORNIA.

VOLUME IV.

STATE PRINTING OFFICE : : : : SACRAMENTO, CAL.
1891.

LIBRARY OF THE
LELAND STANFORD JR. UNIVERSITY.
a. 41957
JUL 13 1900

CONTENTS.

1—Annual Report of the State Board of Horticulture for 1889.
2—Ninth Annual Report of the State Mineralogist.

GENERAL BOOKBINDING CO.
77 53 S PREV. BD.
205ST 005 1 D.R. 2116
QUALITY CONTROL MARK

ANNUAL REPORT

OF THE

STATE BOARD OF HORTICULTURE

OF THE

STATE OF CALIFORNIA,

FOR 1889.

SACRAMENTO:
STATE OFFICE, : : : : J. D. YOUNG, SUPT. STATE PRINTING.
1890.

CONTENTS.

PAGE.

CONDITION OF STATE, Report to Governor 5

TREASURER, Reports of 9-12

SECRETARY, Reports of 14-18

Supplementary 25

Botanical and chemical study, climate and abode, vegetation and life, propagation, varieties, grafting, and budding the olive, and analysis and methods of detecting adulterants in olive oil. Fig culture and propagation. Walnut budding and grafting; strawberry tree; orange packing; commercial classification of lemons; tree planting and arrangement of orchard; injurious insects; fungoid diseases; beneficial insects, etc. 27

BOARD MEETINGS, Extracts from 464

SPECIAL AGENT, Synopsis of reports 472

HORTICULTURAL COMMISSIONS 505

Reports from 477

Conventions, Tenth 289

Eleventh 328

Twelfth 383

Societies, roster of officers 502

EXPLANATION OF PLATES 266

GLOSSARY, Botany 509

Entomology 507

INDEX, to illustrations 519

General 523

STATE BOARD OF HORTICULTURE.

OFFICERS AND MEMBERS.

ELLWOOD COOPER, President........Santa Barbara,
Commissioner for the Los Angeles District.

N. R. PECK,* Vice-President........Penryn,
Commissioner for the El Dorado District.

S. RUNYON, Treasurer........Courtland,
Commissioner for the Sacramento District.

J. L. MOSHER, Auditor........San Francisco,
Commissioner for the State at Large.

F. A. KIMBALL........National City,
Commissioner for the State at Large.

A. F. WHITE........Santa Rosa,
Commissioner for the Sonoma District.

L. W. BUCK........Vacaville,
Commissioner for the Napa District.

I. H. THOMAS........Visalia,
Commissioner for the San Joaquin District.

A. BLOCK........Santa Clara,
Commissioner for the San Francisco District.

EXECUTIVE COMMITTEE.

J. L. MOSHER, Chairman.
ELLWOOD COOPER. FRANK A. KIMBALL.

B. M. LELONG, Secretary........Ex officio Horticultural Officer.
GEORGE RICE........Clerk of the Publishing and Quarantine Bureau.
MISS ELLA HALLAHAN, Clerk. HARRY STANLEY, Messenger.

Office of the Board:
No. 220 SUTTER STREET, SAN FRANCISCO.

---

* Resigned, having moved out of District. Governor commissioned Fred. C. Miles, of Penryn.

REPORT.

OFFICE OF THE STATE BOARD OF HORTICULTURE,
SAN FRANCISCO, December 30, 1889.

To his Excellency R. W. WATERMAN, *Governor, and to the honorable the Senate and Assembly of the State of California:*

In accordance with an Act of the Legislature (Statutes 1889, Section 9, page 91), we respectfully submit for your kind consideration this our annual report for the year 1889.

This State is to-day the greatest fruit-producing State in the Union. "The future of the State of California," to quote from the words of a great statesman, "will equal in its greatness the capacity of the human intelligence for expansion. Nowhere are the conditions of life happier and better; no place on the globe contains so fully the resources necessary for the physical and intellectual improvement of mankind."

Here in this State, as in no other, or, for that matter, in any other equal area anywhere in the world, can the fruits of semitropical and temperate regions be grown to perfection, most edible, and for profit. Here they can be found growing side by side in the same orchard. Here are the orange and apple, the lemon and cherry, the olive and plum, the fig and pear, the pomegranate, the prune, peach, apricot, nectarine, the vine, nuts, and cereals, and so on to the end of the list of fruits grown in both zones.

The growing of almost all these fruits is carried on here as a business. The greatest and most important factor that makes assurance doubly sure to the fruit grower is the equableness of the climate. The intrinsic value of this climate might, as is often slightingly remarked, be truly estimated by the acre, according to what crop the husbandman wishes to produce. The land is worth no more than the same quality, acre for acre, possibly, than it is in Illinois or New York, but when its products bring ten to a hundred times more each year in cash, and all on account of climate, is it not a reasonable conclusion that the acre in California *is* worth ten to a hundred times more than the acre in Illinois or New York? Therefore, the climate is worth the difference between the cash value of the California and Illinois or New York acre, which is largely in favor of the former.

This estimate is from a commercial standpoint, whereas, apart from the intrinsic value, there is the more important one of health, happiness, and a joyous existence.

It is an old saying that "no man can farm against climate." In California the climate is the fruit grower's most powerful ally, and gives substantial aid and comfort at all seasons, and is his best friend.

It is a recognized fact California fruits excel all others. In the markets of the eastern cities they are sought after and command the highest prices. The fresh, canned, and dried fruits, nuts, oils, and wines of California are most favorably known and appreciated, and the improvements now being made in the preparation of all fruits are supplanting all the products in all the great markets of the world. All this, too, when fruit growing is in its infancy in this State.

There are many of the very choicest fruits and nuts that only this, of all the States, can produce in perfection, many new and imported varieties doing even better here than in their native homes.

The facts, as above stated, are fully corroborated by the Department of Agriculture, at Washington, D. C., in its report for 1888, in which many of the rare fruits are accredited entirely to this State, as well as the choicest production of other varieties grown in this country.

The orange, lemon, and lime are grown most successfully in this State, particularly along the foothills of the Sierras, extending from Oroville or Red Bluff in the north to National City in the south. The quality of the orange and lemon may be estimated by the fact that our best fruit always commands the highest prices whenever placed in competition with the imported or Florida crop. In competition with the world at the Exposition in New Orleans they received the highest awards.

Orange culture is in its infancy. Thousands of acres planted in various sections of the State have either not come into bearing or are only yielding their first crops; in fact, none of the orchards are mature, and yet the receipts from this one fruit are already considerable. The following figures are official, and give an idea what may be done with oranges:

For the season of 1888-9, California shipped over three thousand carloads of oranges, which realized fully $1,575,000 to the growers. This does not include a large local and home consumption.

The entire range of deciduous fruits grows to perfection in this State, but it has been found by practical experimenting that almost every kind is more favored in some one locality than another. The prune, for instance, does best in certain locations, while the raisin excels in another. The place to grow the fig has yet to be determined, although it grows and produces fruit in abundance in almost every part of the State. This question is being investigated by this Board, as are many others, and will soon be settled.

The deciduous fruit crop for 1888 has been estimated at two hundred and seventy-five million four hundred and ten thousand pounds, valued at $8,000,000. This is certainly a grand showing for a new industry in a young State. It might seem to the novice that overproduction would be the result of the yield of so many orchards in a few years; but if he will stop to think he will find that the importation of prunes alone into this country amounts to over five million pounds—more than our entire yield of all kinds of deciduous fruits, green and dried.

The peach, one of the most popular of our fruits, is shipped ripe by train loads to the eastern cities, and meets with a ready sale at remunerative prices. Our choice sun-dried and evaporated peaches are snapped up and the market is not nearly supplied, while the demand for our canned peaches and other fruits comes from all over the world.

It is only in this State that the delicious apricot and nectarine are produced in abundance and to perfection. The bulk of this crop is canned, with over three million five hundred thousand pounds dried.

Prune growing and drying has assumed vast proportions. The quality of our dried prunes became known quickly, and they were preferred by all consumers, who could obtain them, above the imported French, German, or Turkish varieties.

The California dried prune has increased from nothing a few years ago to a yield of seven million five hundred thousand pounds for 1888 and a large increase for 1889, to say nothing of one million pounds of other dried prunes and plums. To-day the California prune is master in the great markets, selling this year in advance of from 1 to 1½ cents per pound over the best imported.

A box of California raisins was a curiosity a few years ago, and the total output ten years ago was only seventy-five thousand boxes, while this year about one million boxes of raisins were made. The quality of the raisin, like that of our prune, is placing it in the front rank in the market, and at the present rate of increase in these two products, it is to be hoped we can soon grow at least enough to supply our own country, and exclude the imported article, keep our money at home, and give our people a more wholesome dried fruit. Our product keeps better than the foreign, as it never candies.

Bradstreets (November 30, 1889) announced from New York that "California is beginning to outstrip Spain in the production of raisins. Indeed, Consul Marston, of Malaga, makes the significant statement, that Spanish viticulturists who have suffered of late years from phylloxera, have replaced their vines that had been destroyed, with American stock. That in 1882 the crop of raisins produced in Malaga reached one million nine hundred thousand boxes, of which there were shipped to the United States nearly one million boxes. Since that time the shipments to the United States have been gradually but steadily decreasing. In 1888, when the production amounted to about seven hundred thousand boxes, only one hundred and twelve thousand were exported to this country." Consul Marston adds, that "many Spaniards predict that the vintage of 1889 will reduce still further the purchases made for exportation to the United States, and that in a few years Malaga raisins will be replaced, even for consumption in Spain, by those produced in California."

In addition to the vines planted for raisins, this State is foremost in the production of wine grapes. The wines of this State have just captured one of the grand prizes and several gold medals at the Paris Exposition. This must be from merit alone, as the Frenchman is loath to give up his wine trade in this country. All the choicest varieties of vines grown in Europe flourish equally well here, with the advantage of a virgin soil and a more equable climate. The California vintage of 1888 amounted to eighteen million gallons of wine and three hundred thousand gallons of brandy, from an acreage of one hundred and fifty thousand acres, mostly young vines.

California pears have no rival as a fresh fruit, canned, or dried, and the demand far exceeds the supply. The Bartlett pear belt has inducements to spread as well as room, and will continue to be profitable. The dried product for 1888 was over one hundred and fifty thousand pounds.

The fig grows and produces to perfection, and it has been only within a year or so that any successful attempts have been made to cure it. The same energy and persistent experimenting that has given us the best raisins and prunes, will in the near future give California the best dried fig in the world. The first carload of dried white figs exported was shipped this year from Fresno, and sold at high prices two months in advance of the foreign article.

The olive is at present receiving more attention than almost any other tree. Its adaptability to the climate and soil is marked, and the results obtained in producing an olive oil equal if not superior to the best imported article, are important factors to the intending grower of olives. The California olive oils have the advantage of being pure as put up by the growers, whereas, the imported oils are, as a rule, heavily adulterated, rendering them useless, and, in instances where they have been used in medicinal preparations, positively injurious. The rapid strides in olive culture in this State will soon place her among the great olive-producing countries of the world.

English walnuts, almonds, and peanuts are grown in many parts of this State, and at great profit to the producer. The walnut crop sold in 1888 exceeded one million pounds, bringing the average price, wholesale, of nearly 9 cents per pound—a higher price than is paid for the imported. The almond crop amounted to nearly five hundred thousand pounds, and is considered a profitable crop. The growing of peanuts has just been commenced, and bids fair to become an important industry; the crop of the past season is about two hundred thousand pounds.

There are many other varieties of fruits grown, and at a handsome profit, that we have not mentioned; among them are the loquat, quince, Japanese persimmon, guava, and many others. The bean crop is very large, whole sections of country being engaged in growing beans, and making money at the business.

The question very naturally arises, "will not the production of fruits in California be overdone?" We answer, most emphatically, *no.* Why? The amount of imported fruits, fresh and dried, is more than double the production of this State, and still there are large sections of the United States that have yet to even try our fruit; sections where they cannot grow any kind of fruit successfully, other sections where it will pay the people better to produce something else and buy their fruits.

It is an assured fact that no place, at least in the United States, can grow fruits that can compare with those grown here. Nor can they be produced so easily and surely, without the possibility of a failure, year in and year out.

Respectfully submitted.

ELLWOOD COOPER,
President.

B. M. Lelong, Secretary.

I.

REPORT OF TREASURER.

[SUBMITTED AT THE MEETING OF THE BOARD, APRIL 15, 1889.]

To the honorable State Board of Horticulture:

Gentlemen: I have the honor to submit for your kind consideration this, my final report as your Treasurer, up to April 1, 1889.

The following are the amounts paid in warrants to cover claims against the Board during the fortieth fiscal year, as follows, viz:

July 14—Dutton & Partridge, supplies	$6 00	
The J. Dewing Co., books	36 00	
N. P. Cole & Co., furniture	40 00	
Thomas Parsons, Janitor	7 50	
J. Caire, chemicals	15 90	
George Rice, paper	2 00	
G. G. Wickson & Co., typewriter	100 00	
A. Hayward, rent	85 00	
George H. Ward, Clerk	25 00	
Giles Lithographing Co., litho. plates	600 00	
W. M. Boggs, traveling expenses	18 20	
A. S. Chapman, traveling expenses	54 00	
N. R. Peck, traveling expenses	22 60	
M. G. Vallejo, traveling expenses	15 00	
Ellwood Cooper, traveling expenses	62 50	
Office expenses	154 55	
		$1,244 25
August 2—The Los Angeles "Times," paper	$9 00	
George E. Colby, oil test	5 00	
A. Hayward, rent	85 00	
A. Block, traveling expenses	5 00	
H. S. Crocker & Co., printing	6 00	
Britton & Rey, litho. plates	500 00	
California Wire Works, wire net	35 25	
George Cummings & Co., machinery	97 60	
Dutton & Partridge, supplies	15 35	
W. G. Klee, traveling expenses	44 90	
Office expenses	48 60	
		851 70
August 21—San Francisco "Chronicle," paper	$7 80	
San Francisco "Examiner," paper	7 80	
Dutton & Partridge, stationery	1 35	
"California Fruit Grower," paper	3 00	
H. S. Crocker & Co., printing, etc.	59 50	
History Publishing Company, books	16 50	
The Bancroft Company, books	22 00	
J. Caire, chemicals	8 25	
C. C. Reidy, insect cuts	30 00	
A. Hayward, rent	85 00	
Thos. Parsons, Janitor	7 50	
G. H. Ward, Clerk	25 00	
W. G. Klee, traveling expenses	48 10	
Office expenses	41 59	
		363 39
September 22—Dutton & Partridge, supplies	$6 85	
Chas. C. Reidy, insect cuts	7 00	
The Bancroft Company, books	9 75	
Ayers & Lynch, Los Angeles "Herald"	8 00	
Sacramento Publishing Company, "Record-Union"	6 00	
Geo. H. Ward, Clerk	25 00	
Thos. Parsons, Janitor	7 50	
A. Hayward, rent	85 00	

G. Wickson & Co., supplies	$14 50	
H. S. Crocker & Co., printing	27 50	
Samuel Carson & Co., books	5 00	
California Furniture Company, furniture	18 00	
W. G. Klee, traveling expenses	22 45	
Office expenses	241 33	$483 88
October 31—San Francisco "Call," one year	$7 80	
San Francisco "Guide," one year	6 00	
Dutton & Partridge, supplies	6 33	
H. S. Crocker & Co., wood cuts	91 00	
Union Box Factory, boxes	12 00	
Thos. Parsons, Janitor	7 50	
Geo. H. Ward, Clerk	25 00	
J. Caire, chemicals	14 70	
The J. Dewing Company, books	25 00	
C. C. Reidy, insect cuts	10 50	
Dewey Engraving Company, engravings	15 00	
A. Hayward, rent for November	85 00	
W. G. Klee, traveling expenses	22 55	
Office expenses	83 57	411 95
November 17—H. S. Crocker & Co., supplies	$31 00	
Dutton & Partridge, supplies	5 00	
Thos. Parsons, Janitor	8 50	
A. Hayward, rent for December	100 00	
Geo. H. Ward, Clerk	25 00	
W. G. Klee, traveling expenses	9 65	
Office expenses	340 84	519 99
December 14—Thomas Parsons, Janitor	$7 50	
H. S. Crocker & Co., wood cuts	153 00	
Dutton & Partridge, supplies	18 95	
A. M. Ebbetts, coal	4 50	
A. Hayward, reut for January	100 00	
Edwin Kimball, traveling expenses	30 90	
N. R. Peck, traveling expenses	31 55	
W. G. Klee, traveling expenses	34 15	
Ella Hallahan, salary as Clerk	40 00	
G. G. Wickson & Co., supplies	3 50	
The J. Dewing Publishing Co., books	9 50	
James Duffy & Co., carpets	83 60	
California Furniture Co., furniture	60 00	
A. K. Whitton, reporting Chico Convention	200 00	
Minnie V. Lelong, sketching	45 00	
Ellwood Cooper, traveling expenses	64 20	
M. G. Vallejo, traveling expenses	43 90	
Office expenses	322 25	1,260 10
January 19—"Alta California" Publishing Co., "Alta" one year	$5 40	
"Overland Monthly" one year	4 00	
Thomas Parsons, Janitor	8 50	
The J. Dewing Publishing Co., books	16 00	
H. S. Crocker & Co., books	54 75	
Dutton & Partridge, supplies	15 35	
Britton & Rey, litho. plates	88 50	
Neville & Co., sacks	13 32	
A. K. Whitton, extra report	9 40	
Union Box Factory, boxes	44 52	
W. B. Dunlap, books	10 50	
Ella Hallahan, salary as Clerk	40 00	
A. Block, traveling expenses	30 80	
F. A. Kimball, traveling expenses	84 90	
Office expenses	184 45	610 39
January 26—Dutton & Partridge, supplies	$3 80	
A. Hayward, rent	115 00	
Sol. Runyon, traveling expenses	36 90	
California Furniture Co., chairs	47 50	203 20
February 18—Dutton & Partridge, supplies	$17 00	
Geo. Cummings & Co., supplies	4 50	
Thomas Parsons, Janitor	8 50	
California Furniture Co., supplies	10 00	
A. Hayward, rent	100 00	

Ella Hallahan, salary as Clerk	$50 00	
Office expenses	114 70	$304 70
Salary, Inspector, six montbs, at $200	$1,200 00	
Salary, Secretary, nine months, at $150, and additional	1,355 02	
Salary, Clerk, one month, at $50	50 00	2,605 02
Total		$8,858 57
Balance from thirty-ninth fiscal year		1 63
State appropriation		11,000 00
Balance in treasury		$2,143 06

Very respectfully submitted.

M. G. VALLEJO,
Treasurer.

SAN FRANCISCO, April 2, 1889.

II.

TREASURER'S REPORT.

[SUBMITTED AT THE MEETING OF THE BOARD, NOVEMBER 4, 1889.]

To the honorable State Board of Horticulture:

Gentlemen: I have the honor to submit for your kind consideration this, my report as your Treasurer, up to November 1, 1889.

The last report of my predecessor was up to April 1, 1889, and at that time there was a balance of unexpended funds in the State Treasury of $2,143 06, for the balance of the fortieth fiscal year, ending June 30, 1889.

The following are the amounts paid in warrants to cover claims as follows, viz.:

April 15, 1889—A. Hayward, rent of office	$100 00	
Thos. Parsons, Janitor	17 00	
Dewey & Co., "Rural Press" one year	3 00	
Office expenses and supplies	249 80	$369 80
May 4, 1889—Dutton & Partridge, supplies	$8 27	
H. S. Crocker & Co., supplies	28 25	
Jas. Duffy & Co., supplies	8 25	
The J. Dewing Publishing Co., books	2 00	
Thos. Parsons, Janitor	8.50	
A. Hayward, rent	100 00	
W. B. Dunlap, books	27 50	
Ellwood Cooper, traveling expenses	54 53	
N. R. Peck, traveling expenses	64 20	
L. W. Buck, traveling expenses	75 50	
N. W. Motheral, traveling expenses	62 30	
J. L. Mosher, traveling expenses	73 00	
Sol. Runyon, traveling expenses	78 00	
A. K. Whitton, reporting Eleventh Convention	200 00	
Office expenses	90 05	880 35
May 25, 1889—A. Hayward, rent	$100 00	
Office expenses	73 55	173 55
June 29, 1889—Office expenses		52 73
Salary, Secretary, three months (less $10)	$515 00	
Salary, Clerk, three months	150 00	665 00
Total		$2,151 43
Amount expended as per last report		8,858 57
State appropriation		$11,000 00

Forty-first Fiscal Year.

July 15, 1889—San Francisco "Chronicle," one year	$7 80	
San Francisco "Examiner," one year	7 80	
H. S. Crocker & Co., electro cuts	50 00	
A. W. Rose, rent	117 50	
Dutton & Partridge, supplies	8 37	
Swan & Stein, painting	55 00	
Jas. Duffy & Co., carpets, etc.	75 00	
California Furniture Co., furniture	575 80	
W. L. Bovyer, carpenter work	275 00	
J. L. Mosher, traveling expenses	20 90	
A. F. White, traveling expenses	110 75	
Ellwood Cooper, traveling expenses	59 70	
Samuel C. Partridge, supplies	$119 95	
Office expenses	720 46	$2,202 37
July 23, 1889—Samuel Carson & Co., books	$543 50	
James Duffy & Co., supplies	3 00	
W. B. Dunlap, books	10 00	
California Furniture Co., furniture	28 00	
Dutton & Partridge, supplies	41 05	
Frank A. Kimball, traveling and incidental expenses	163 40	
Office expenses	31 25	820 20
August 10, 1889—Union Box Factory, boxes	$45 72	
Dutton & Partridge, supplies	49 00	
Samuel C. Partridge, supplies	42 50	
W. L. Bovyer, carpenter work	51 50	
Samuel Carson & Co., books	263 50	
Thomas Parsons, Janitor	19 00	
The Giles Co., lithographing	1,000 00	
P. J. Healy, books	20 00	
N. W. Motheral, traveling expenses	214 95	
Office expenses	798 35	2,504 67
September 5, 1889—Chris. Jorgenson, water color sketching	$67 00	
Swan & Stein, painting	7 50	
J. R. Dobbins, salary	81 00	
"California Fruit Grower," printing	28 00	
H. S. Crocker & Co., wood cuts	17 00	
P. J. Healy, books	5 00	
Dewey & Co., books	23 00	
"Daily Appeal Co.," "Appeal" one year	6 00	
California Furniture Co., supplies	8 00	
Samuel Carson & Co., books	5 75	
N. W. Motheral, traveling expenses	21 35	
George Rice, traveling expenses	79 50	
Office expenses	183 27	532 37
September 7, 1889—Samuel C. Partridge	$5 00	
Sacramento Publishing Co., "Record-Union" one year	6 00	
Dutton & Partridge, supplies	5 00	
Swan & Stein, painting	2 50	
H. S. Crocker & Co., supplies	17 00	
N. W. Motheral, salary	150 00	
A. W. Rose, rent	135 00	
Office expenses	189 50	510 00
Total		$6,569 61
Appropriation		12,500 00
Balance in treasury		$5,930 39

Salary Fund.

Secretary, four months	$700 00	
Clerk of P. and Q. B., four months	700 00	
Secretary's clerk, four months	200 00	$1,600 00
Appropriation		4,800 00
Balance		$3,200 00

Very respectfully submitted.

SOL. RUNYON,
Treasurer.

San Francisco, November 4, 1889.

III.

REPORT OF SECRETARY.

[SUBMITTED AT THE MEETING OF THE BOARD, APRIL 15, 1889.]

To the honorable State Board of Horticulture:

Gentlemen: I have the honor to present for your kind consideration my report as your Secretary, since your last meeting, held at Chico, November 25, 1888.

PUBLICATIONS.

The manuscript of the proceedings of the Chico Convention has been in the hands of the State Printer since last December, but other publications were given precedence, as they had been somewhat delayed. To this report I add an appendix, being the reports from the fruit-growing sections of California, of the varieties of fruits of all kinds under general cultivation, new fruits, and general observations. Nearly every section of the State is represented, and when issued will be of great value. This information was collected by myself at considerable expense and hard work. I also issued a bulletin on the olive, in which the various new varieties of olives in general cultivation in this State were fully illustrated; also the new and improved methods of budding and grafting. I had expected to issue in the month of March the second or revised edition, but was unable to do so, as no printing could be had during the meeting of the Legislature, and it was also for this reason that I was unable to carry on further investigation. I have prepared considerable valuable matter for the second edition.

The demand from the Senate and Assembly for all our reports was very great. I was kept very busy supplying Senators and Assemblymen with the same. I was told that no other reports were so much sought for by their constituency as the reports of this Board. Over five thousand copies were placed at their disposal, and when the Legislature adjourned not one copy could be found. Several members requested that they be furnished with a copy to take home. This I mention merely as an illustration of the demand for all of our publications, and because it is more than any other institution can boast of, for hundreds upon hundreds of their reports were lying on the floors of the Senate and Assembly, and were at all times being trampled upon, seemingly few caring for them.

FINANCES.

The following is the total amount expended up to April 1, 1889:

July 1, 1888—Balance from thirty-ninth fiscal year		$1 63
April 1, 1889—Expenditures	$6,253 55	
Salaries	2,605 02	
Total	$8,858 57	
State appropriation		11,000 00
Balance		$2,143 06

QUARANTINE GUARDIANS.

The County Board of Horticultural Commissioners of San Bernardino, Mendocino, and San Mateo Counties petitioned to have all their Inspectors appointed Quarantine Guardians, and in the absence of a State quarantine officer, the President, who is authorized by law to issue commissions for any vacancies that may occur until the following meeting, issued commissions to the following, which I recommend be confirmed: Mart Bechtel, C. R. Thomas, Carl Purdy, J. H. Clark, W. E. Collins, H. B. Muscott, Bradford Morse, C. L. Hanson, G. R. Turner, C. R. Paine, S. B. Fox, W. A. Brouse, J. H. Pearson, N. H. Claflin, Judson House, W. E. Brummagim, W. L. Stroud, Robinson Jones, W. T. Noyes, P. M. Couburn, W. J. McNulty, J. Bright, L. D. Morse, and Alexander Moore. The said Boards have divided the said counties into Inspector Districts, and have assigned an Inspector to each district.

LEGISLATION.

In accordance with your action at your last meeting, the committee appointed therefor, formulated a bill, and asked the Legislature for its adoption. The bill was introduced into the Assembly by Hon. C. A. Storke, and in the Senate by Hon. E. H. Heacock. I appeared before a joint meeting of the committees to which the same was referred, and presented various petitions and memorials in support of the same. The bill was very much amended, and was reported back with the recommendation that it should pass as amended. It passed the Assembly, and when transmitted to the Senate was referred to the Committee on Agriculture. In this committee it was again further amended and reported back with the recommendation that it pass as amended. The bill was championed by Senator Frank C. De Long of Marin, during the absence of Mr. Heacock. He fought with great will all obstructionists, and the bill passed without further amendments. On the fourteenth of February I received a copy of the approved bill, and to my surprise a mistake appeared in the enrolled copy. The word "twenty" was substituted for the word "seventy," and was as such signed by the Governor. As the bill that passed the Legislature contained the word "seventy," and as the bill signed by the Governor did not contain the word "seventy," but in substitution thereof the word "twenty," the bill signed by the Governor had never passed the Legislature, and was therefore null and void. I had a concurrent resolution introduced, which was made a case of urgency and adopted by both houses, requesting the Governor to request the Secretary of State to return the bill to the Governor, and that the Governor return the same to the Assembly for reënrollment. The Secretary of State, in his reply, addressed to the Speaker of the Assembly, said:

> Referring to Assembly Concurrent Resolution No. 14, addressed by your honorable body to this office, requesting the return of Assembly Bill No. 4 to the Governor, and by him to the Clerk of the Assembly, I beg most respectfully, and under the solemnity of my oath of office, to say that a bill passed by both branches of the Legislature, approved by the Governor, and in all respects properly authenticated and filed in this Department, is a law of this State over which this office has no control except safely to keep. If a Legislature can recall one bill, it can recall another; and if for one purpose, then it can for another purpose; and certainly with regard to any bill passed being destroyed prior to adjournment. While it is felt that no harm could result from the return of Assembly Bill No. 4 for the purpose as presented in said resolution, yet the principle is deemed illegal and dangerous as a precedent.

The only recourse left for me was to have the bill reintroduced and, if possible, reënacted. Mr. Heacock introduced the same bill in the Senate on the fourth of March, and the following resolution:

Resolved, That Senate Bill No. 655 presents a case of urgency, and that the term in use in Section 16, of Article IV, of the Constitution, requiring that a bill shall be read on three several days in each House, is hereby dispensed with, and it is ordered that said bill be read for the first, second, and third times on one day and placed upon its passage.

The resolution was adopted, and the bill, then being Senate Bill No. 655 instead of Assembly Bill No. 4, was read the first and second times, ordered engrossed, and read the third time, and passed; and upon motion of Mr. Heacock was immediately transmitted to the Assembly. In the Assembly, through the aid of Hon. T. W. H. Shanahan, of Shasta, the bill was read the first time and made a special order for March fifth, immediately after the reading of the Journal. It was on that day, by direction of the Speaker, considered in the House in Committee of the Whole. After due consideration the Speaker presented the following report:

GENTLEMEN: The Committee of the Whole have had under consideration Senate Bill 655—An Act to amend Sections 3, 6, 7, 8, and 12 of an Act entitled "An Act to create and establish a State Board of Horticulture, and appropriate money for the expenses thereof," approved March 13, 1883, and an Act amendatory thereof, approved February 18, 1885, and adding five new sections to said Act, to be known as Sections 14, 15, 16, 17, and 18, and to repeal Section 9 of said Act, and to appropriate money for the uses of the State Board of Horticulture—and now report progress and recommend that the same do pass.

The report was adopted and the bill ordered to third reading, and on motion of Mr. Shanahan the further consideration of said bill was made a special order for March sixth, immediately after the reading of the Journal. On March sixth the bill, being the special order, was taken up and read the third time and passed, and was on the same day transmitted to the Senate for enrollment. It was transmitted by that body to the Governor on the seventh day of March, and was by him signed on the eighth day of March. An amendatory bill to the horticultural bill of 1881, which will greatly aid the fruit-growing counties of this State, was also passed. The old bill to which this is amendatory, has been on the statute books as a dead letter, for the reason that it provided in no way for the enforcement of its provisions. The passage of this bill is due to the efforts of Senator J. E. McComas, of Pomona, and Assemblyman E. W. Holmes, of Riverside.

APPROPRIATION.

Through the General Appropriation Act, the following amounts were allowed for the uses of the Board:

Salary of Secretary	$4,200 00
Salary of Clerk of Quarantine and Publishing Bureau	4,200 00
Salary of Clerk to Secretary	1,200 00
For uses of the Board	25,000 00
Total	$34,600 00

These amounts are for the forty-first and forty-second fiscal years.

The payment of the following amounts were authorized in addition to the above:

Deficiency for the fortieth fiscal year, ending June 30, 1889, $1,000, and $1,145 83, being deficiency bills contracted by the Board in 1887, during a hiatus of three months, at which time there was no appropriation or funds upon which to draw for any expenses whatever.

You are no doubt acquainted with the delay which all claims against the State meet at the hands of the State Board of Examiners. At times we have had to wait three months or more to obtain a warrant. The Governor recommended the creation of a State Board of Auditors, which would have remedied this delay, but the bill failed to pass the Legislature. A revolving fund is very much needed. I therefore recommend that the President and Secretary be authorized to sign a note for the sum of $500 (five hundred dollars), this amount to be used as a revolving fund.

During the entire session of the Legislature I was kept very busy attending to all business connected therewith between the office and Sacramento.

In view of the fact that the passage of these bills is entirely due to the great efforts of Senators Heacock, De Long, and McComas, and Assemblymen Holmes, Storke, Shanahan, and others, I most respectfully recommend that a committee be appointed by your honorable body to draft a suitable set of resolutions, to be properly engrossed, and that they be transmitted to the Hon. E. H. Heacock, Hon. Frank C. De Long, Hon. J. E. McComas, Hon. E. W. Holmes, Hon. T. W. H. Shanahan, Hon. C. A. Storke, and others, in recognition of the active efforts on their part to secure proper legislation in the interest of horticulture; for rarely do we find men so devoted to the interests of their constituency. An expression of appreciation from you is no more than is due these men, who, in time of need, showed themselves true friends of horticulture, and who fought for your interests in general and the welfare of the whole State.

Respectfully submitted.

B. M. LELONG,
Secretary.

SAN FRANCISCO, April 15, 1889.

IV.

SECRETARY'S REPORT.

[SUBMITTED AT THE MEETING OF THE BOARD, NOVEMBER 4, 1889.]

To the honorable State Board of Horticulture:

GENTLEMEN: I have the honor to submit to your kind consideration this, my report as your Secretary, since your last meeting, held at National City, April 19, 1889, and the special session held at the office in San Francisco, June 30, 1889, and for the year 1889:

PUBLICATIONS.

The official report of the tenth State Convention of Fruit Growers, held at Chico a year ago, has been issued. There were eight thousand copies printed in paper covers and two thousand in muslin. The application for this report has been very large and it is considered of great value. The appendix contains the reports of the leading fruit-growing sections throughout the State, being reports upon varieties of fruits of all kinds under general cultivation, new fruits, general observations, etc.

The official report of the eleventh State Convention of Fruit Growers, held at National City, in April last, has also been issued. There were ten thousand copies printed—eight thousand in paper covers and two thousand in muslin—being a pamphlet of one hundred and sixty-one pages. The report of the Chico Convention contains three hundred and two pages. The demand for the National City Convention report was also very large, and the issue is about exhausted.

A synopsis of both of these reports will, however, appear in our forthcoming annual report. The quarantine regulations issued by you at the session of June 30, 1889, were printed as the law directs, in two newspapers for twenty days, and posted in every Court House bulletin, as far as I know, throughout the State. In order to distribute them among the fruit growers, I had ten thousand of these regulations printed in Bulletin No. 53. The demand for these bulletins was so large that I found it necessary to have another edition of ten thousand printed. Since your last meeting four bulletins have been issued, as follows:

Bulletin No. 51. Laws relative to horticulture, and remedies recommended for the destruction of injurious insects; ten thousand copies.

Bulletin No. 52. Reports of the San Bernardino and Tulare County Horticultural Commissioners; ten thousand copies.

Bulletin No. 53. Regulations to prevent the spread of contagious diseases among fruit trees; prevention, treatment, cure, and extirpation of fruit pests and diseases of fruit and fruit trees; and for the disinfection of grafts, scions, orchard debris, empty fruit boxes, etc.; twenty thousand copies.

Bulletin No. 54. Report of the Sutter County Board of Horticultural Commissioners; ten thousand copies.

The expense of mailing is and has been very large. During the past year I have mailed over thirty thousand publications, and besides these there have been shipped in boxes upwards of fifty thousand publications. These publications have been sent only to persons within our State, excepting to our regular exchanges throughout the United States and foreign countries.

MEMORIALS.

In accordance with resolutions adopted at the National City Convention, I forwarded to his Excellency, the President of the United States, and the honorable the Secretary of State, a memorial, in which the needs of this coast were fully set forth in the matter of the introduction of parasites, and a series of questions, to be forwarded to the United States Consulates, with reference to the cultivation, treatment, and processing of citrus fruits, the olive, and the fig, and also with reference to the parasites that prey upon injurious insects, and methods of treatment, etc., and requesting that instructions be issued to answer fully. The President acknowledged the receipt of said memorial, as also did the Secretary of State, and in reply suggested that I should prepare the questions to be forwarded to the Consulates throughout the country. In accordance therewith I formulated a series of questions, which have been forwarded to the Consulates. It is to be hoped that replies from them will be of benefit to the horticulturists of our State.

Through the aid of United States Consulates, I secured for our library all the reports published in their respective countries. Many of these are of the highest value, and I have had many subjects of great interest to our State translated, which will appear in our next annual report.

QUARANTINE GUARDIANS.

Since my last report the following have been commissioned Quarantine Guardians, viz.:

Alameda County—Wm. Barry, A. P. Crane, A. D. Pyral.
Humboldt County—J. D. Barber, A. P. Campton, Jacob Zehendner.
Kern County—L. W. Burr, C. A. Maul, M. Wyatt.
Los Angeles County—John Burr, C. A. Cauffman, George H. Compere,* J. A. Driffill, Wm. E. Garry, Isaac Gibbs, Hiram Hamilton,* F. H. Keith, Albert Kercheval, O. H. Leifeld, F. F. Miller, S. J. Miller, C. H. Richardson, C. Warren.
Mendocino County—Mart Baechtel, J. H. Clark, Carl Purdy, C. R. Thomas.
Nevada County—George Beale, J. A. J. Ray, George T. Beale, John Rodda, James Nagle, S. N. Stranahan.
San Benito County—E. W. Bowman, G. Brown, J. A. Schoefield.
San Bernardino County—E. G. Carr, W. W. Phelps, S. P. Hall, W. G. Porcine, C. H. Lathrope.
San Joaquin County—Wilber S. Allen, Joseph Hale, W. H. Robinson, George W. Wise.
Santa Barbara County—R. Machin, T. N. Snow, O. W. Maulsby.
Sutter County—J. C. Gray, R. C. Kells, H. P. Stabler.
Tulare County—C. M. Stone, I. H. Thomas, J. N. Wright.
Ventura County—N. B. Smith, M. E. Isham, N. W. Blanchard.
Yuba County—G. W. Harney, Jas. W. Mills, F. W. Johnson.
State at Large—N. W. Motheral.*

HORTICULTURAL COMMISSIONS.

The good resulting from the Horticultural Commissions as required by law, is almost incalculable. It is true that in many counties no appointments have as yet been made, whilst in others the appointments have been rendered ineffective from want of sufficient appropriation of funds by the County Supervisors, to properly carry on the work. There are, however, a number of counties wherein the County Board of Horticultural Commissioners have been properly sustained by the Supervisors and the people.

---

*Resigned.

The fruit growers themselves have, in every instance, cordially assisted the Commissioners, where they were properly sustained and supported by the County Board of Supervisors.

The work accomplished by the Commissioners above referred to have more than returned value received to the county by the appreciation in real estate, and thereby increasing the tax roll of the county, thus producing what returns to the County Treasury more in dollars and cents than is paid out for the work. Again, it has caused to be returned to the orchardists an increase in his receipts for the extra quantity and quality of his fruits produced and sold. The facts and figures for the above statements are before us as we write.

Again, it tends largely to encourage the planting of orchards. It induces the newcomer to settle in those counties where he can see the progress, and where he knows his orchard will be protected. Who would settle in a city or community where no precautions were taken to not only prevent sickness, but where no effort was made to abate any of the dread scourges that already existed? The comparison is not unreasonable, because it is a daily occurrence in all the fruit-growing counties of this State to-day, where the intending settler is choosing to plant his vine or fig tree in the county that guarantees him protection.

Since the Act entitled "an Act to protect and promote the horticultural interests of the State," was amended by the last Legislature, the following counties have complied with the law, and have appointed Boards of Horticultural Commissioners, as follows, viz.: Alameda, Butte, Colusa, Humboldt, Kern, Los Angeles, Mendocino, Nevada, Orange, San Benito, San Bernardino, San Joaquin, San Mateo, Santa Barbara, Sonoma, Sutter, Tulare, Ventura, and Yuba Counties.

OUR NEXT REPORT.

The law as to the time we are to report to the Legislature has been amended to read "annually" instead of "biennially." The manuscript of this report will be forwarded to be printed on or about the first of January, 1890. This report will contain a synopsis of the reports of the Chico and National City Conventions, as well as the report of the coming Fresno Convention, together with the reports of all the officers. It will contain four lithographic plates and numerous wood engravings. It will be a volume of nearly twelve hundred pages, and, I believe, will be the best report of the kind ever published.

EXECUTIVE COMMITTEE.

The Executive Committee, in pursuance to law, met at the rooms of the Board in San Francisco, on July 1, 1889. The meeting was called to order by Hon. Ellwood Cooper, President of the Board, who, having stated the object of the meeting, announced nominations for President in order. Commissioner J. L. Mosher was unanimously elected President. The committee then formulated instructions for the Special Agent of the Board to visit San Mateo, Santa Clara, and Los Angeles Counties, in search of parasites; the qualifications, and as to whom the people of Southern California desired sent, in case an agent could be appointed to go in search of parasites. On August 1, 1889, the Executive Committee had another called meeting, at which time the Special Agent was directed to go to Sacramento County, and to there make a thorough investigation, and find out if the eastern plum curculio had made its appearance in that county, and if found, to enforce the law, and cause all infected fruit to be destroyed. Also to investigate with regard to scale insects and remedies therefor. Also to go to Placer and Nevada Counties in search of parasites, and to investigate the most effectual remedies used.

On August 3, 1889, the Executive Committee again met and transacted the following business: There were present Commissioners Mosher, Cooper, and Kimball. The Clerk of the Publishing and Quarantine Bureau was instructed to at once proceed to Los Angeles and make a thorough investigation with regard to the reported presence there of the eastern plum curculio, and, if found, to enforce the law and cause all infected fruit to be destroyed. The Clerk was also instructed to ship to the office cuttings of trees parasitized with the Aphelinus (a parasite on the San José scale), for distribution among the orchardists; also, to cause the *Vedalia cardinalis* (a ladybug destroying the scale) to be multiplied by distribution wherever cottony cushion scale existed at that time, instead of spraying.

On August 27, 1889, the Executive Committee again met. There were present Commissioners Mosher, Cooper, and Kimball. The Special Agent was instructed to visit Butte, Sutter, Yuba, and Nevada Counties, to make in those counties such investigations as pertain to that office; also, to visit the Sutter County Horticultural Society at its regular meeting at Yuba City.

On September 30, 1889, the Executive Committee held its regular called meeting. At this meeting the Special Agent was instructed to visit Colusa, El Dorado, Tehama, and Yolo Counties, in the line of duty pertaining to his office.

On October 26, 1889, the Executive Committee met. There were present Commissioners Mosher, Cooper, and Kimball. The Special Agent was instructed to visit Fresno, Tulare, Kern, and Tuolumne Counties, and there make such investigations as pertain to that office, and to take such observations as may be of general interest.

The Special Agent has filed monthly reports, in accordance with instructions, covering the investigations made, a synopsis of which will appear in our forthcoming annual report.

NO CURCULIO IN THE STATE.

During the month of July there appeared in various papers statements to the effect that the curculio had appeared in Los Angeles and at Sacramento. These statements caused considerable alarm, and after full investigation proved groundless. A rose beetle was mistaken for the curculio, and the report put afloat that the curculio had made its appearance in this State. Since then statements have been published that the curculio will not live in this State. This theory not being established by facts, I shall be loath to believe it, as our climate is very much milder than the Eastern States, and is therefore wonderfully favorable to the propagation and dissemination of injurious insect pests.

INTRODUCTION OF PARASITES.

At your meeting of June 30, 1889, it was resolved to send an agent to Australia and New Zealand and adjacent countries in search of parasites. The authority of the Board sending such agent was questioned, and the subject-matter was submitted to the Attorney-General. The Attorney-General rendered his opinion as follows:

The appropriations made for the uses of the State Board of Horticulture must be understood with reference to their power and duties as defined. The attention of the Attorney-General has not been called to any provision which would justify sending an entomological expert to Australia and New Zealand, nor indeed, to employing such an expert here.

Mr. Albert Keobele says that it is his opinion that it is useless to send an agent to Australia or New Zealand in search of parasites. He says that no parasites were found in those countries preying on the red scale, and also says that the red scale there is even worse than it is in this State, thus indicating that no parasites exist there. He reports that the pernicious, or San José scale, does not exist in those countries. He says that a qualified entomologist, under the direction of the United States Department of Agriculture, should be stationed in Australia for a few years to study the injurious and beneficial insects, their parasites, etc., and adds that the beneficial insects of Australia are very numerous, and the largest part of them could, without doubt, be introduced successfully into this country and State. The trees that arrive from Japan are generally affected with red scale (*Aspidiotus aurantii*), but at no time has there ever been found parasites on them. An internal parasite near the genus *Coccophagus*, a minute four-winged fly, scarcely as large as the head of a small pin, has made its appearance in the San Gabriel Valley, preying on the red scale. This important parasite has been observed in nearly all the orange groves in that valley. In several orchards the work of this parasite is clearly visible. There are several orchards there that are now practically free from the red scale, purely the work of this parasite. I have taken pains to propagate this parasite in the northern part of the State, and several colonies have been placed on trees infected with the same kind of scale that it attacks in the San Gabriel Valley.

Another parasite has been discovered that keeps the pernicious, or San José scale, in check. It is also an internal parasite—a small, four-winged fly, of the genus *Aphelinus* (See Parasites). This parasite was discovered preying on the pernicious, or San José scale, about two years ago. The orchard in which it was found was at one time so badly infected that the owner had determined to grub it up; a year after the trees showed a much healthier condition and had made fine growth. The cause of this was looked into, and the parasite mentioned was discovered. This same parasite has also been observed preying on the willow scale, and, in fact, Professor Coquillett says that it is also a parasite of the willow scale, *Aspidiotus convexus*. It also appeared in Santa Clara County some ten years ago, a full account of which is to be found in the report of the Department of Agriculture for 1880. The Sonoma County Horticultural Society petitioned the Executive Committee to have several colonies of this parasite imported into Sonoma County. In accordance with said petition, several colonies have been placed on trees infected with San José scale in that county, and it is to be hoped that they will increase rapidly, so that they may be distributed into other orchards. Colonel J. R. Dobbins was appointed a Special Agent to colonize this parasite in San Gabriel.

In Florida an orange scale, *Limacis* (See Parasites), has made its appearance. Mr. Ashmead reports that "it was but a few years ago that the orange groves of Florida had been blasted and ruined by scale insects; that this wonderful and welcomed foe of these pernicious pests made its appearance," and adds that "if those minute foes be removed from Florida but for a season the scales would so increase in numbers as to utterly destroy all orange trees, and another panic in orange culture would ensue, as disastrous and uncontrollable as the one witnessed in the years from 1835 to 1840." I have made arrangements to have several lots of these parasites shipped to this State. Arrangements have also been made for their colonization.

CONCLUSION.

Since the position of Inspector of Fruit Pests was discontinued by you (January 1, 1889), and its subsequent abolishment by the Legislature at its last session, all the work of this department devolved upon me, until the latter part of July, 1889. During this time (six months) I managed to perform the work, doing what I could in the daytime and finishing up at night. Considerable has been accomplished during the past year, all of which will appear in the forthcoming annual report.

I have carried on experiments in processing fruit in the field and in the experimenting room with great success. The work in the experimenting room will be continued through the winter.

Since the office of Clerk of the Publishing and Quarantine Bureau, and that of Special Agent have been filled, I have been more at liberty in the performance of my work, as these two officers are now performing the duties that once devolved upon me. I hope you will not consider it out of place in saying that they have been very successful in their work, and have rendered the State valuable service.

In conclusion, I beg to say that Commissioner Block failed to receive his official notification of the special meeting held June 30, 1889, for which reason he was recorded absent. The letter was mailed, but failed to reach its destination. The postal authorities have been unable to trace it, and I exceedingly regret that this letter, which is the first I ever had lost, should have failed to reach the Commissioner, as it was the reason of his non-attendance.

Very respectfully submitted.

B. M. LELONG,
Secretary.

San Francisco, November 4, 1889.

SUPPLEMENT

TO THE

REPORT OF B. M. LELONG,

Secretary of the State Board of Horticulture.

EX OFFICIO HORTICULTURAL OFFICER.

V.

THE OLIVE.

BOTANICAL STUDY.

OLEACEÆ AND THE OLIVE.

OLIVE, a genus of trees and shrubs of the natural order *Oleaceæ*, having opposite evergreen leatherly leaves, which are generally entire, smooth, and minutely scaly; small flowers are compound axillary racemes, or in thyrsi at the end of the twigs; a small four-toothed calyx, a four-cleft corolla, two stamens, a two-cleft stigma, the fruit a drupe. The common olive (*Olea europæa*), a native of Syria and other Asiatic countries, and also of the south of Europe. In its wild state, a thorny shrub or small tree, but through cultivation, becomes a tree of great height, destitute of spines; attains a prodigious age. The cultivated varieties are very numerous, differing in the breadth of the leaves and in other characters.

OLEACÆ, exogenous trees, an order extended to include the *Jasmines*, *Ash*, *Olive*, *Lilac*, *Privet*, etc.

OLEASTER, a small ornamental tree, noted for its silvery foliage and fragrant flowers.

OLEA (Genus) includes several species, such as the olive of America (*Olea americana*), a rather small tree, of broadly lanceolate leaves and compound racemes, of small white fragrant flowers, and remarkable for the extreme hardness of its wood.

Olea paniculata, a large tree, attaining a height of fifty to sixty feet in the forests of Queensland, and yielding a hard and tough timber; *Olea laurifolia*, a much harder wood; an inhabitant of Natal.

OLEACEÆ AND THE OLIVE.

According to Degrully and Pierre Viala, systematic botany has made rapid progress of late years. The external morphology (study of the forms which the different organs assume, and the laws that regulate their transformations) of the flower, which, in most cases, was deemed sufficient whenever researches were made for the mere purpose of drawing up the catalogue of phanerogamous (flowering) plants and of determining the date of extension of families and genera, no longer satisfies the ambition of botanists. As long as too precise distinctions were not made, and one remained within the Linnaean conception of the species, serious difficulties were seldom met with. A few particularly delicate points, however, were calling for new methods and other processes of investigation. Moquin-Tandon searched into teratological facts (malformations and monstrosities); Payer consulted the flower before its blowing, to learn from it the modifications it has undergone in the course of its development.

Organogeny (the production or development of organs in plants) does not always enlighten us, though, on the original state of a flower. The absence of one or several stamens (the male organs of a flower) in a normal cycle (set) of androecium (the stamens collectively), the disappearance of one or several carpels (the rolled-up leaves which contain the ovules), the primitive position of the ovules (young seed) in the cells of the ovary (the seed vessel in a young state), the morphological value of the different parts of the flower, cannot be surely determined by the study of organogeny.

From its insufficiency was born the comparative anatomy of the flower. Its first applications have actually worked a revolution in science; the masters of science, brought up to worship ancient traditions, were not long finding out all what the knowledge of plants could derive from the application of the new *processes.* There is no longer a botanist to-day who does not consider the simple manner of the last century as having given about all that could be expected from it.

The knowledge of the flower has freed itself thereby, from the empirical methods which were hindering its progress. The researches which are multiplying since a quarter of a century have become the A B C of the systemization of phanerogams. The results of these researches, for a long time scattered in a multitude of publications, have fallen into the classical domain, thanks to a few works which have embodied them in a doctrinal system. It is sufficient to recall that, owing to the new methods, the tie is now demonstrated between vascular Cryptogams (flowerless plants provided with cells and vessels) and Phanerogams (flowering plants) through the medium of Gymnosperms (naked seeded plants).

Whatever may be thought of it at times, the flower does not possess the exclusive privilege of revealing the secret of affinities. Long since botanists, the least conversant with anatomical researches, have known how to deduce useful indications from the existence or the absence of laticilerous vessels (vessels conveying the latex, a milky juice), of oleo-resinous canals, of the presence or the absence, and of the form of hairs; they have given the example to anatomists. The masters have then, from an early period, called upon the processes which science applies to-day in a regular manner.

Is it to say that all the morphological and anatomical characters have to be consulted in order to determine the place of any plant? It must be said, a few people have misunderstood the thought of the adepts of the new school. It is not purposed to include in the characteristic of each plant all the characters which it may furnish; this would be misunderstanding the fruitful principle of the dependence of characters. It is useless, for instance, to ask comparative anatomy to furnish us new ties between the Solaneæ and the Scrophularineæ; the external morphology of the flower sufficiently establishes them. But is not the structure of the blown flower too often mute when it is questioned to determine the affinities?

Be it sufficient to recall what the anatomy of the flower has learned us about the Loranthaceæ and the Santalaceæ, on the apparently terminal ovules of the Compositæ and the Polygoneæ, on the central placentation (disposition of the seeds in the ovary) of the Primulaceæ. The flower itself does not always exist; has not comparative anatomy enabled us to reconstitute partly the flora of primary strata?

It is then a well established fact to-day that the study of botany cannot be considered as confined between the calyx (outer envelope) and the carpels of a blown flower. We are seeking to know the laws of life; we must, in order to succeed, first know the whole organism; there is no doubt about it.

If these principles be applied to the special study of Phanerogams, all the groups do not present the same interest; some are so homogeneous, so like each other, that any species reveals nearly the history of the group; but there are other very remarkable associations, in which, outside the absolutely constant characters, may be observed an extreme variableness for other characters. Among the gamopetalous (having the petals united), dicotyledons (plants with a two, rarely several, leaved embryo), the Oleaceæ, considered in a broad sense, that is to say including the Jasmines, the Syringas (Lilacs), and the Ashes, constitute a most interesting subject of study. United by the structure of their seed, we see the various representatives of this group marked by deep differences in the structure of their flower: apetalous (without petals), dialypetalous (petals free), or gamopetalous (petals united), of their androecium, of their ovary, and of their fruit. Largely represented in the Mediterranean region, to which they furnish the first element of its wealth, the Oleaceæ singularly favor the application of some of the modern processes of systematic botany.

The first attempts that have been made to fix the natural places of Olives and allied plants, already denote two opposite tendencies. Some people, like Tournefort, Lindley, Brongniart, hold the Olives as quite distinct from the Jasmines, and do not find between these plants enough common characters to class them together. Others, following the example of Linnaeus, bring them together, on the contrary, to make of them, according to the epoch and the special views of each, either members of a same group or of neighboring families; such are Endlicher, A. L. de Jussieu, Ventenat, R. Brown, Decaisne.

The two opinions are blended to-day, the morphological studies and comparative anatomy having proved beyond a doubt that the Oleaceæ and Jasminaceæ are in fact closely allied; the isolation of each of them, or their reunion, depends solely upon the manner in which the different authors conceive the family. Thus, Mr. Eichler has been led to make of the Jasminaceæ and the Oleaceæ two distinct families; they alone, however, forming, among the sympetalous (petals seemingly united), haplostemonous (of simple stamens) dicotyledons, the class of Ligustrineæ.[‡]

We are indebted to this scholar for having established the nature of the relations of the corolla with the androecium, the application of which had escaped the sagacity of Brongniart. A few scholars have had, of the group we are now considering, a notion hardly explainable in view of modern

---

There is, in actual science, a tendency to suppress ancient denominations to replace them by more significative designations. It seems to us that there are many inconveniencies in so doing, and we admit, with Mr. A. De Candolle, that "the designation of a group does not purpose to point out the characters of the history of that group, but to give a means of understanding one another while speaking of it."[*]

---

[*] Nomenclature Botanique, Geneva, 1883.

According to Tournefort,[*] the character of the fruit separates the Olive from the Syringa in a manner which seems to us the more marked, as he interposes the Elm between them. Lindley[†] makes of the Oleaceæ the first family of his forty-sixth alliance (Solanales); the Jasminaceæ are classed among the Echiales (forty-eighth alliance), together with the Salvadoraceæ, of which we shall speak again ourselves. Brongniart finds the affinities of the Oleaceæ extremely doubtful, and enlarges especially on the very unusual relations of the corolla (inner envelope of the flower) and the two stamens. He therefore places the Jasminaceæ by the side of the Globularieæ, according to the structure of the fruit, while the Oleineæ are included in his class of Diospyroideæ.

---

[*] Institutiones, 1719.

[†] Vegetable Kingdom, 2d ed., 1847.

[‡] Flora brasiliensis, 1868.

science. Thus, Adamson* divides the Jasminaceæ in three sections—the first contains the general *Eranthemum* (Acanthaceæ), *Comocladia* (Terebinthaceæ, Solaneæ, Loganiaceæ, Rubiaceæ, Peneaceæ, Plantagineæ)—it would be difficult to imagine a more heterogeneous association. On the other hand, the Ash is excluded and placed by the side of the Cisti.

Leaving aside this theory, which is wholly abandoned to-day, we then find ourselves in presence of two opinions relative to the Oleaceæ and the Jasminaceæ. Mr. Eichler, among our contemporaries, has advocated the distinction of the two families. Mr. Van Tieghem adopts this opinion, attributing to the two groups the value of a tribe; he even associates the Salvadoraceæ with them.† M. M. Bentham and Hooker go still further, for the Jasminaceæ, the Fraxineæ, the Chionantheæ, and the Syringeæ become for them as many tribes having the same value with respect to the whole.‡ These differences of appreciation, more apparent than real, result, as we have already said, from the relative importance each believes should be attached to the family. The equilibrium, which it is expedient to establish in this connection between the various vegetable groups, leads us to conceive it in a more synthetic sense than has been done by Tournefort, Jussieu, Lindley, and Brongniart, and we shall endeavor to pry into the general characters of the Oleaceæ, associating them with the Jasminaceæ.

Having studied the whole of their characters, it shall be an easy task to find out to what extent it is expedient to associate them or distinguish them in secondary groups.

The *essential characters* of the plants we are considering are furnished by the androecium (male organs of the flower) and the gynoecium (female organs of the flower). The androecium is almost invariably composed of two stamens alternate with the carpels, rarely of four stamens inserted on the tube of the corolla, or uniting the petals two by two, or hypogynous (inserted below the ovary or pistil) when the corolla is lacking. The gynoecium is, without exception, formed of two united carpels, with axile placentation (the placentæ or ovule-bearing processes facing the axis of the flower), making a cross with the two stamens. The calyx and the corolla are, on the other hand, very variable; both are wanting at times, or else one or the other of these two cycles is more or less abortive, or else the corolla is dialypetalous (*Hesperelex*), or nearly dialypetalous (*Fontanesia*), or distinctly gamopecalous (*Syringa*). It is the aggregate of these characters which Linnaeus had grasped with his habitual sagacity, when he included in his Diandria Monogynia all the genera then known which we now group under the denomination of Oleacea.

Real difficulties, however, soon made their appearance. It was noticed that the more of aestivation (arrangement of the floral organs in the bud) in the corolla of the Jasmines is imbricate (the envelopes overlapping each other), whereas that of the Olives is valvate (the contiguous edges of the parts touching throughout their length like the two leaves of a door); that the anthers (the part of the stamen containing pollen) of the former are basifixed (attached by their base) and those of the latter dorsifixed (attached by the back); that the ovule of the Jasmines is ascending (attached a little above the base of the ovary), whilst the ovule of the Olives is pendulous (hung from the upper part of the ovary); that the albumen is much lessened or wanting in the first at maturity, when the seed of the second is provided with a fleshy albumen. It was urged that on the Jasmines the stamens are antero-posterior (inserted in a direction from behind forward), with respect to the axis of inflorescence (the arrangement of the flower on the stem), whereas they are situated at right and left on the Olives. The anthers themselves, very short in the Oleineæ, opening sidewise, have been found very different from the anthers of the Jasminaceæ, which are oblong, linear, often apiculate (terminating abruptly by a small point), and internally dehiscent (opening by regular splitting). Lastly, the stigma (the glandular part of the pistil which receives the pollen), following the laws of floral symmetry, forms a cross with the stamens, that is to say, its lobels are antero-posterior in the Olives, lateral in the Jasmines.

These differences have seemed important enough to justify the separation of the two types and the establishment of two families.

Care was also taken to cite, in support of this distinction, a character of quite a different order, and bring forward anatomico-physiological phenomena in behalf of the separation into two families. Thus it has been advanced that the necessity of distinguishing the Oleaceæ from the Jasminaceæ arises from the fact, well known in horticultural practice, that the Syringa, Fraxinus, Chionanthus, Fontanesia, Phillyrea, and Olea graft without great difficulty upon one another, whereas true Jasminaceæ never graft on Oleaceæ, properly so called. Great stress was further paid on this other fact that the cantharis (Spanish fly) eats up the Ashes, then the Lilacs, the Privets, and if need be, the Olives, without ever attacking the Jasmines; that the larva of the species *Tinea syringella* feeds upon the parenchyma (cellular tissue) of the leaves of Lilacs, Ashes, Fontanesia, Forsythia, and Ligustrum, while it never touches those of the Jasminaceæ.

It was going very far for an answer to a real difficulty, and above all asking an answer from unscientific processes; undoubtedly the selection operated by the mandible of insects may be very exact, but we have to-day direct means of reaching the solution of this problem.

Mr. Van Tieghem, the first one, tried to ascertain the intimate structure of the flower in several species of this group; for, let us say it at once, teratology has not thrown the least light on the comparative structure of the Jasminaceæ and the Oleaceæ.

This scholar has particularly studied the anatomy of the flower of the *Forsythia viridissima*.* He has observed the original independence of all the parts of the flower, each cycle corresponding to a series of independent fascicles; the greater or lesser joint growth of the several parts is then merely parenchymatous. The stamens are most always two in number, while there are four sepals (calyx leaves) and four petals (corolla leaves). In the *Jasminum officinale* (common White Jasmine), in which no peculiarity whatever is revealed on the outside, the same scholar has discovered the existence of four staminal fascicles, two of them effectively correspond to stamens; the two others are lost without producing anything. Circumstances might occur where these abortive stamens could more or less be developed outwardly.

Mr. Eichler demonstrated a few years later that the calyx of the Oleaceæ, *sensu stricto* (in the restricted sense), is always formed of two decussate (crossing each other) cycles.† The leaves of the outer one are usually larger than those of the inner. In the Jasminaceæ the calyx is formed of a single cycle of petals, save rare exceptions (*Jasminum nudiflorum*); there is, however, in the floral symmetry a still greater difference. In the Oleaceæ the stamens correspond to the inner sepals, the carpels to the outer sepals; it is the reverse in the normal Jasminaceæ. Thus the plane of the stamens of the former is perpendicular to a plane passing through the axis

---

* Familles des plantes, 1763.
† Traite de Botanique, 1547.
‡ Genera Plantarum, 1876.

* Memoirs des Savants, 1871.
† Bluthendiagramme, 1875.

of the stanens of the Jasminaceæ. Various reasons, however, permit us to consider as very likely that the corolla is formed of two heteromerous (unrelated as to parts) cycles, the outer one polymerous (formed of many parts), the inner constantly dimerous (composed of two parts), which in the *Jasminum nudiflorum* alternates with the stamens.

Such are, in brief, the reasons which have determined Mr. Eichler to hold the Jasminaceæ and the Oleaceæ as two distinct, but closely allied, families. This is, we repeat, a secondary point, which proprieties of another order cause us to view in a different light.

We consider, above all, that Phanerogams have been too much dissociated in secondary groups, that their differences have been too much insisted upon of late years, and that it is important, lastly, that the notion of the family be alike, whether it be a question of Phanerogams or of Cryptogams.

Resuming, then, after this discussion, the study of Oleaceæ in the broad sense, let us examine, now, the aggregate of their characters, and, in order to proceed according to the habitual mode, let us study first the inflorescence and the flower.

The *inflorescence* of Oleaceæ is generally a dichotomons (stem dividing by twos) cyme (a kind of inflorescence in which the primary axis terminates in a flower between two opposite leaves or bracts, from the axils of which spring two secondary axes, each again terminated by a flower between two bracts, from the axils of which spring two tertiary axes, and so on, until the last axis fails to repeat the process), or a panicle (a form of inflorescence in which the cluster is much and irregularly branched), with ramifications more or less concentrated, centripetal (when the flowers at the circumference or base open first), or centrifugal (when the central flower opens first).

We have seen that the floral symmetry is very characteristic. The orientation of the flower with respect to the axis bearing it had always escaped observation—it seemed very variable. Mr. Eichler has shown it to be very closely related to the existence and position of two bracts or leaves of inflorescence, which are the first productions of all floral branches. The first calycinal cycle is always perpendicular thereto. The flower of the Olive is orientated, as if it had bracts, although these productions are actually lacking; they can then, it seems, be considered as abortive, while in the *Fraxinus dipetala* their place is not even indicated. Save these rare exceptions, the variable disposition of the pistil and the androecium in the Oleaceæ appears to depend solely upon the development of the bracts.

The *flower* is always actinomorphous (radiate), oftener hermaphrodite (having both stamens and pistil), seldom polygamous (hermaphrodite flowers occurring amongst the male or female), or dioecious (having the stamens on one plant and the pistils on another). [*Fraxinus*, *Foresteria.*]

The *calyx*, wanting in the *Fraxinus* of the *Brumeliodes* section and in a few *Foresiera*, is ordinarily dialysepalous (its sepals are separate), small, campanulae (bell shaped), in most cases tetramerous (in four parts), sometimes pentamerous (in five parts), then having an anterior median sepal, occasionally hexamperous (in six parts). There are, in all cases, slight differences betwen the two calycinal cycles.

The *corolla*, oftener gamopetalous (the leaves cohere more or less so as to form a corolla of a single piece), hypocrateriform (salver-formed), or campanulae, is occasionally dialypetalous (petals entirely separate from each other) It is a phenomenon of purely parenchymatous growth. In several cases the petals are found to be united on the sides opposite the stamens, and deeply separated, or free forward and backward (*Fontanesia*, *Loniciera*, *Iotolaea*). The corolla is formed of four petals, usually crossing the sepals, and therefore diagonally situated with respect to the axis of the flower. It has, in exceptional cases, in *Fraxinus dipetala*, but two petals corresponding to the outer sepals. The corolla is even wholly wanting in the *Gymnelaea* section of the *Olea*, and in *Fraxinus*, sections *Melioides* and *Brumelioides* of Endlicher. Mr. Eichler has also often observed male flowers of the *Fraxinus ornus* (Flowering Ash) without corolla.

The modifications which we have just pointed out in the corolla of Oleaceæ, are fruitful in precious instructions. These two facts, that the dipetalous (two-petaled) corolla of the *Fraxinus dipetala* is opposite to the outer cycle of the calyx, and that the two stamens are always opposite to the inner cycle of the calyx, seem to afford a very serious argument in behalf of the hypothesis which sees in many dicotyledonous (embryo having two cotyledons, or temporary leaves) families a monocyclic (simple) corolla opposite to a dicyclic (double) calyx. This interpretation is unquestionable as regards the *F. dipetala;* but even where there are four petals, the relative position of the stamens is the same.

Now, if there were two cycles in the corolla, floral symmetry would exact that the petals lie opposite the inner sepals, which never occurs.

In all other plants of the family, we find four petals, but the relative disposition of the other parts is in nowise modified. The *Fraxinus dipetala* would then answer to the schema (symbol of the floral structure in Oleaceæ), and could be expressed by the formula $S_2+2P_2E_2C_2$.

The term P_2 would be replaced by P_4 in the *Syringa*, *Olea europæa* (the European or common olive), etc.; there is no deduplication (occurs when two or more organs take the place of one). This hypothesis is incompatible with the laws of floral symmetry, for in this case the stamen would correspond to the median nerve of a deduplicated petal.

When the corolla is wanting, there is simply a normal or accidental abortion according to cases; the general symmetry of the flower is in nowise disturbed thereby.

The androecium is characteristic; we know it. It is nearly always formed of two stamens, always opposite to the inner calycinal cycle. It is so composed in the cultivated Olive, where this disposition is the easier to observe, as the stamens are relatively very large. The regular and constant alternacy of the androecium, with the carpels and the dimerous (two-parted) corolla of the *Fraxinus dipetala*, the absence of all trace of other stamens noted in several species, seem to prove that this dimerie (disposition by twos) of the androecium is normal.

The *Tessarandra fluminensis* (Miers) furnishes, though, a remarkable exception. This Brazilian plant possesses four stamens alternate with four sepals. One cannot then admit a deduplication of two stamens, but rather a case of normal tetramerie (disposition in fours).

Thus the androecium, usually dimerous, can be tetramerous like the corolla; but there is, it must be borne in mind, only one staminal cycle, as is proven by the unchanging position of the carpels. They invariably correspond to the outer sepals, whereas they would necessarily alternate with them if the two antero-posterior stamens of the *Tessarandra* belonged to a new cycle alternate with the two lateral stamens.

It is not without interest to recall here the observation made by Mr. Van Tieghem on the *Jasminum officinale.* By the side of the two fascicles corresponding to the two stamens, he has found two others which correspond, according to him, to two complementary stamens. It may be admitted that these two stamens, abortive in most Oleaceae, have been developed in the *Tessarandra.*

This tetramerie of the androecium realized at times, gives great strength to the opinion of Gardner and Wight,[*] relative to the Salvadoraceæ. These scholars, without knowing the case of the *Tessarandra*, have placed these plants near the Oleaceae and the Jasminaceæ. Mr. Planchon[†] accepts with some hesitancy this classification, which the better knowledge of floral morphology fully justifies to-day. The *Tessarandra* furnishes the transition term which was wanting at the epoch when Planchon was studying the Salvadoraceæ.

The *anthers* are usually introrse (when the sutures are turned towards the center of the flower), large, oval, oblong, dorsified. They are extrorse (sutures turned towards the circumference of the flower) in the *Linociera*. The anthers have a longitudinal dehiscence (mode of splitting at maturity).

The *gynoecium* is *invariably* composed of two carpels, forming a cross with the two stamens, and opposite to the outer sepals. They unite in a two-celled ovary, with axile placentation. Each cell ordinarily contains two collateral ovules, one of which is often abortive. The lobes of the stigma (the granular part of the pistil which receives the pollen) correspond to the middle of the carpels.

The ovules are anatropous (reversed) or semi-anatropous, pendent with an external raphe (the continuation of the seed-stalk along the side of an anatropous ovule or seed, forming a ridge or seam), Oleaceæ *sensu stricto*, or ascending with an internal raphe (Jasminaceae); exceptionally, three to ten ovules are found in the *Forsythia*, one alone by abortion in some Jasmines. The ovules are monochlamydeous (have a single covering).

The style (the cylindrical or tapering portion of the pistil between the ovary and the stigma) is usually short, not projecting out, or barely projecting out of the corolla, capped by a thick or capitate (growing in a head) stigma, most always bifid (two-cleft) at the top. It is not without interest in this connection to note the observations of Mr. R. Pirotta on the floral dimorphism (the property of occurring under two distinct forms) of the *Jasminum revolutum*. This scholar has noticed that this plant has longistyle (long-styled) flowers and brevistyle (short-styled) flowers.[‡] There is every reason to believe that the difficulties met with in the specification of a few plants of the family which we are now considering, result from the fact that these phenomena of dimorphism have been misunderstood; this is, at least, what seems to result from the observations of Darwin, of Mr. Asa Gray, and of Mr. Th. Mechan, on the *Forsythia*.[‖]

The nectaries (honey glands), when there are any, never form a disk (a part intervening between the stamens and the pistils in the form of scales, a ring, etc.). In the Jasmines, the Privets, and the *Syringa*, the parenchyma of the ovary is sacchariferous on all its outer surface, although there is no special differentiation of the tissue.

Let us recall incidentally that the Ashes are particularly subject to the phenomenon of honey dew; we know that it is but a simple exudation, at the surface of the leaves, of a sweet liquid which escapes from the tissues owing to a very active transpiration.[§]

The fruit presents variations, the importance of which has been diversely appreciated according to the epoch and the state of science. At the time when external morphology alone was furnishing characters, the fruit, with its different forms, seemed of capital importance; now it is known that its

---

[*] Journal of Natur. History.
[†] Annales des Natur. Botan. p. 189.
[‡] Reudic. del R. Instit. Lombardo, 1885.
[‖] Proceedings of Academy of Natural Sciences of Philadelphia, 1883.
[§] Bonnier, Les Nectaires, Annales des Sc. Natur. Botan., 1879.

origin is always the same, that its differences are superficial, and more important and durable characters are preferably considered. However, the dicarpellary (two-carpelled) ovary becomes a loculicidal (dehiscing through the back of the carpels) capsule (a dry seed vessel) in the *Syringa* and the *Forsythia*, a septicidal (splitting through the edges of the carpels) capsule in the *Nyctanthes*, a samara (a winged dried fruit) in the *Fraxinus* and *Fontanesia;* teguments thicken to form a berry in the Privets and the Jasmines, and, as but one ovule is transformed into seed in the *Olea*, *Phillyrea*, and *Chionanthus*, the fruit becomes a drupe.

The *fruit* contains two to four seeds, oftener reduced to a single one at maturity, by abortion of part of the ovules; they are erect (fixed to the bottom of the cavity of the fruit) or pendent (the top turned towards the base of the fruit), according to the insertion of the ovules.

The embryo, straight, has always a short radicle (young root) more or less hidden between the cotyledons, sometimes as long as the cotyledons, and a gemmule (first bud) scarcely indicated.

The nutritive reserves disposed of by the embryo are in relation with the development of the cotyledons. All Oleaceæ (*sensu stricto*) are provided with an abundant cellulose albumen loaded with fatty matter, never amylaceous (starchy), as erroneously stated by Endlicher[*]; it contains *albuminoids*, poluhedral (many-sided) grains of *aleurone*, with beautiful crystals of oxalate of lime, *globoids and crystalloids* (Pirotta, *Sulla struttura del seme nelle Oleaceæ*[†]); in these plants, the embryo has foliaceous cotyledons, oval or oblong. The albumen is wanting in the Jasminaceæ, which have, on the contrary, thick and fleshy cotyledons; the absence of albumen is, as we have seen, one of the characters the most relied upon for the distinction of the two groups. However, since we know what little physiological importance has the existence or absence of albumen in the ripe seed, it is more than ever expedient to admit the already old idea of Ventenat[‡] about the prudence with which the characters drawn from the albumen have to be applied.

At the time of germination, the cotyledons are always epigeal (raised and appearing above ground), durable, and perform the functions of leaves after their reserves are exhausted. They present, from the beginning of the germination, the normal structure of the leaves; the disposition of their tissues is clearly bifacial (having the opposite surfaces alike).

Is it needful, after these instructions, to insist on the anatomy of Oleaceæ considered in the broad sense in which we have been looking at them? We do not think so. It seems to us that floral morphology has sufficiently determined the characters of the whole, and shown us its affinities in a satisfactory manner. Moreover, were we to consult the anatomical structure, we would very soon observe that the Oleaceæ have the structure the most commonly found in ligneous vegetables. We must, therefore, expect but few useful results from anatomical study. Mr. Vesque has, nevertheless, given the anatomical diagnoses of Oleaceæ *sensu stricto*:[‖]

> Pentate hairs scarce, ordinarily reduced to small unicellular (one-celled) papillæ (nipple-shaped protuberances), seldom more developed, uniseriate (in single rows), panci-cellular (few-celled); glandular hairs sessile (stalkless), capitate, with their head vertically divided, or in a pluri-multi-cellular (many-celled) shield. Stomata (lip-like cells), surrounded by several irregularly disposed epidermal cells very seldom, and by accident, by two cells parallel with the ostiole (a small aperture), usually larger than the surrounding cells. Crystals acicular (needle-shaped), not orientated, very small, rarely mixed with lamellar

---

[*] Genera Plantarum, p. 572, sub. Olea.
[†] Reudic, Instit. Lombardo, 1883.
[‡] Tableau du regne Vegetal.
[‖] Annales des Sc. Natur. Botan., 1885, 7th ser.

(disposed in this plates), prismatic, or octahedral (having eight equal faces) forms, much scattered throughout the tissues, frequent in the epidermis. Laticiferous vessels and other internal glands wanting.

It seems to us useful to bear in mind that the Jasminaceæ have glandular capitate hairs, with a uni-pluricellular head, little different from that of the Oleaceæ. As to the other characters, they are as common as possible between the two groups.

Since morphology and the development of the flower have learned us about all we can expect with respect to Oleaceæ, it would not be necessary, it seems, to enumerate anatomical characters which offer nothing peculiar. Such a great importance, nevertheless, has been attached to these characters of late years, that we do not hesitate to bring into relief the efforts that have been attempted in order to draw from comparative anatomy new elements for the distinction and diagnosis of the group.

Beginning by the *root*, we know that the terminal growth of this organ proceeds in Oleaceæ according to the mode most frequent in dicotyledons. The radicle (the rudimentary stem from which the root is developed downward) presents from the start the initials peculiar to the central cylinder, to the bark, and to the epidermis with the covering. In this respect there is no difference between Oleaceæ and Jasminaceæ.[*]

Mr. L. Oliver[†] has studied the tegumentary apparatus of the root of the Ligustrum and Fraxinus. Its primary bark is thick; the piliferous (bearing hairs) layer, very regular, is soon replaced by the subjacent epidermatoid layer, the elements of which thicken. The bark is vaguely separated into two zones. The elements of the endoderm (inner skin) preserve their partitions thin. The *pericycle* is formed from the start by a layer of large cells with white and cellulose partitions. The whole cortical (belonging to the bark) tissue is developed into cork and exfoliates (scales off), with the exception of the endoderm, which will be destroyed itself and exfoliated by the appearance of secondary formations. These appear from side to side of the *pericycle*, which forms, outwards, a thick muff of cork unceasingly reproduced; inwards, a secondary parenchyma of restricted growth confining a zone of very thick fibers analogous to liber (the inner bark lying next to the wood). The *libero-ligneous* fascicles of the root do not present any peculiarity worth mentioning; the ligneous and *liberian* elements are narrow, as a rule.

The *stem* of Oleaceæ is most often ligneous erect. A few are voluble (winding) at the right and climbing (*Jasminum*), a few others herbaceous.

The anatomical structure of this organ has been the object of particular researches a few years since. We have taken pains to control them ourselves, in the hope of finding out whether or not the stem of Oleaceæ can furnish interesting characters for the distinction of the entire group, or of its subdivisions. We have been unable to find any. It may be remarked at once that there are not between the vessels of different ages notable differences of diameter; there is a great uniformity in the nature and thickness of the elements of the wood, so that the yearly layers are difficult to recognize.

Let us choose a lignified branch of the *Fraxinus excelsior* (Common Ash), as has been done by Mr. Olivier,[‡] or a branch of some age of Olive, of Privet, or Alaterne; we can observe but insignificant differences in the structure of the stem. Beneath the epidermis borne on a few selerous (bony) layers, we find a suberous (cork-like) layer, then a parenchymatous layer, containing chlorophyl (green coloring matter) and starch. This layer, more or less developed, is borne on *liberian* fibers, which do not differ from those of the root.

---

[*] Annales des Sc. Natur. Botan., 1878, 6th ser.

[†] Annales des Sc. Natur. Botan., 1881, 6th ser.

[‡] Annales des Sc. Natur. Botan., 1881, 6th series.

MM. Sanio, Russow, and Kohl have successfully studied the wood with regard to histological structure (that of tissues). They have shown a few peculiarities worth describing.

Thus, Mr. Sanio has found out, in the tracheal (hollow cells in woody tissue) of the Olive, perforations which establish a normal communication between all of them, as has been observed in a great number of vessels with oblique partitions (tracheides). When the punctate (dotted) vessels lie directly against *sclerenchymatous* (term applied to hard vegetable tissues) fibers, they usually have no dots on their surfaces of contact. Mr. Sanio has found some in the Olive, although less numerous than when the vessels are in contact with other vessels.

The medullary rays (the rays of cellular tissue which pass from the pith to the bark) are formed of one of three layers of narrow parenchymatous cells; the pith is homogeneous, formed of cells with thick partitions.

In the *Olea americana*, Mr. Kohl has observed ligneous vessels of two sorts, the ones large, with small and narrow dots, the others narrow, with large dots; its pith is also unusually heterogeneous, the outer cells being much thicker than the inner cells.

The *leaves* of Oleaceæ are opposite, very seldom alternate (a few Jasmines) or verticillate (arranged around a stem like the rays of a wheel), simple or pansifoliate (of few leaflets) pennate (feather shaped), entire or toothed, always destitute of stipules (appendages at the base of leaves), save in Salvadoraceæ, where filiform (thread-like) stipules are found. Organogeny demonstrates, however, according to Mr. Pirotta, that the oppositeness of the leaves is more apparent than real, for the two foliar protuberances are not contemporaneous; one of them has a higher development than the one facing it, and they are not, in fact, inserted on a same transversal plane.

The anatomical structure of the leaf is in relation with the outer appearance, and all the more differentiated, as the organ is thicker. A very clear differentiation is usually observed between the two faces of the leaf; the stomata are scarce at the upper face, underneath the epidermis of which is developed a powerful palisade-shaped tissue.

The comparative anatomy of the leaf of Oleaceæ has been the object of a close study on the part of Mr. Pirotta.[*]

The leaf is always covered by an epidermis formed of a single layer of cells rich in tannin. It is thin (*Syringa, Fontanesia, Forsythia*) or thick (*Olea, Notelea*); on the petiole (leaf-stalk) the epidermal cells are more or less prismatic, longitudinally elongated; on the limb (leaf-blade) they are polygonal, pretty irregular; their lateral partitions are rectilinear (Phyllyrea, etc.) or flexuous (curving) *Chioanthus olea.* This character is susceptible of modification, to a certain extent, under the action of outside influences. The epidermal cells frequently contain crystals of oxalate of lime, sometimes grouped in raphides (*Olea*), but at other times isolated in very flat octahedrons (*Olea undulated*), and then scattered through all the mesophyllum (the parenchyma of a leaf between the skin of the two surfaces). The raphides are more particularly located in the epidermis and the medullary rays of the secondary bark.

Many Oleaceæ possess only the glandular hairs, the development of which has been carefully studied by Mr. Prillieux.[†] This savant has shown that there is identity between the disciform (disk-shaped) hairs o Oleaceæ and Jasminaceæ; that these hairs differ only by the degree of development arrested sooner or later according to cases. Very abundant in some of these plants, they are scarce in others, or confined to the petiole or to the main nerve of the limb (*Forestiera*, *Notelea*, *Osmanthus*). Their definitive form depends upon their development, but it is well to note that nearly always, despite their glandular origin, the terminal cells of the hairs of Oleaceæ contain nothing else but air when in the adult state.

---

[*] Ann. dell' Instit. Botan. di Roma, 1885.

[†] Ann. de Sc. Botan., 1856, 4th ser.

The non-glandular hairs are scarce and generally reduced to small, much thickened conical papillea, which are found hardly elsewhere than on the petiole. The *Olea glandulifera* alone has long uniseriate hairs, confined to special cryptae (round receptacles with which the leaves are studded), situated at the axil (angle) of the nerves and at the under face.*

The stomata occur only at the under face of the leaves; however, a few are occasionally found at the upper edge of the leaves of the *Ligustrum vulgare* (Privet); they are always disposed without apparent order on the surface of the limb. Mr. Weiss has counted six hundred and twenty-five of them on .03 of a square inch in the cultivated Olive.† In a few species two kinds of stomata are found, the one much smaller than the other, but they are generally large and surrounded by several epiderman cells.

Aquiferous (conducting a watery fluid) stomata, grouped in threes or fours, are observed towards the edges of the leaves of *Ash*, of *Forsythia*, and of *Phillyrea*, and in the neighborhood of the vacular terminations.

The mechanical system of the Olive leaf is well known since the publication of the researches of Mr. Areschong.‡ It is known to be very powerfully developed in the Olive, as in most species having persistent leaves.

It was interesting to submit this physiological tissue to a particular study in a group where the leaf presents so great variation with respect to its consistency and its duration. It is also to Mr. Vesque and to Mr. Pirotta that we owe very minute details on this point. If we consider the Olive as a starting point, we can summarize what we know of it, by saying that the mechanical system, always of the same fundamental nature, diminishes as the leaf is more fugacious. All the intermediaries between the *Olea* with hard leaves and the *Syringa* are thus observed. In the species with caducous (falling off quickly) leaves, the mechanical system is oftener reduced, in the petiole, to a little collemchyma (the substance lying between and uniting cells); the median nerve reproduces the same structure; but frequently two horns detached from the facicle approach each other and unite to form a second fascicle inverse of the first, at the upper face. The collemchyma diminishes by degrees on the secondary nerves as we get near the assimilating tissue. We shall see further on that sclerous cells issued from the mesophyllum come and increase the protection of the parenchymatous tissues; it is well to state that the collenchyma always appears the more developed as the sclerous cells are less in number.

The sclerous cells do not exist everywhere. Many Oleaceæ have the leaf tissues tender, are malacopyllous. According to the expression of Mr. Vesque there is no trace of sclerous cells in the *Phillyrea*, *Forsythia*, *Forestiera;* they are scarce in the Ligustrum, Fraxinus, Syringa. Everywhere else they are more or less developed, especially in the assimilating tissue, which they particularly aim to render more resisting. They are short (*Fraxinus*, *Juglandifolia*, *Chionanthus fragrans*), in a column, in all the assimilating tissue of the leaf of the *Picconia excelsa* and of the *Osmanthus*,

---

* Vesque, Annales des Sc. Botan., 1885, 7th ser.

† Pringsheim's Jahrbücher, IV, p. 124.

‡ Jemforanda Lund, 1878.

irregularly remous (branchy) in the Olive, the two epiderms of which they strongly support; often, also, these various sorts of protective cells are met at the same time in the tissues of the leaf (*Notelea*, *Olea*).

The mechanical system is further increased by *libriform* sclerenchymatous fibers, more or less developed in the nerves, according to genera.

The vascular system is formed in the petiole, of a single fascicle, narrowly bent like a bow, accompanied or not by two small lateral fascicles.* This fascicle is frequently disjointed and separated into several groups by narrow medullary rays. The fascicle is open, that is to say, provided with a cambrium (a viscid secretion) restricted in its working, such as Mr. Van Tieghem has indicated in many ligneous dicotyledons.†

A cross-section of the Olive petiole shows that the liber is composed of large parenchymatous elements, in the midst of which are found here and there groups of much narrower cells, which seem issued of the division of the preceding ones. Mr. de Bary sees in it latticed vessels or *cambriform* cells; this soft liber is outwardly surrounded by thick libriform sclerenchymatous fibers. The development of these fibers, very weak in the *Forsythia suspense* and in the ligustrum, reaches its maximum in the *Notelea*. The ligneous part of the fascicle is very compact, formed of elements disposed without apparent order in the inner part, in regular radial series in the outer region. The radial series of dotted vessels with thick partitions, alternate in it with the rows of parenchymatous cells.

The pith is relatively considerable in the petiole, and more or less surrounded by the concave ventral border of the disjointed fascicle; its cells are irregular; its innermost layer, constituted by elements larger, more regular; oval in cross-section; forms the *amyliferous* sheath.

The assimilating tissue is insensibly developed in the petiole toward the root of the limb; its differentiation is effected in a green parenchyma and in a palisade-formed tissue, which has two to four superposed series, five even in the *Picconia;* its thickness is, besides, variable with the different points of the limb, but no interesting characters can be drawn therefrom. The lacunous (containing cavities) parenchyma is usually thicker than the palisade-formed tissue; its cells have variable forms and dimensions, circumscribing narrow meati (passages) or large lacunes (air cells), according to genera. It always contains much tannin, and here and there crystals of oxalate of lime.

The fall of the folioles (leaflets) of the Ash takes place as in most all other trees, by the formation of a layer of cork at the point of insertion of the foliole.‡

The preceding details sufficiently show that no particular of the anatomical structure of the plants we are considering has been neglected; nevertheless, has our notion of the Oleaceæ become any clearer in consequence? In no way. The flower, which furnishes in Phanerogams the most important characters, was sufficient alone to give us a satisfactory knowledge of the whole. It is to the works of Mr. Van Tieghem and of Mr. Eichler that we owe to be able to determine the natural place which the Oleaceæ must occupy in the aggregation of corollifloral plants and their affinities with the neighboring groups; they have left no important problem unsolved, as regards the floral morphology. It seems useless to us, in this particular case, to inquire into the anatomical structure, which was not likely to furnish any new indication; it has remained silent, in fact, and all these efforts have simply resulted in showing us that the structure of Oleaceæ, save a few insignificant exceptions, is that of the majority of dicotyledonous vegetables. Let us ask of anatomical structure a notion which the flower could not furnish; it is logical. But what interest is there in rejecting floral morphology, when it is sufficient to enlighten us, to replace it by characters which the microscope alone can reveal? The results gained in the last few years do not seem fit to encourage much those who believe they had found in comparative anatomy the key to all problems.*

---

* Vesuqe, Ann. des Sc. Botan., 1885, 7th ser.

† Bulletin de la Soc. Botan. de France, XXVI, 1879.

‡ Van Tieghem and Guignard, Bulletin de la Soc. Botan. de France, XXIX, 1882.

Mr. A. De Candolle has published in the *Prodrome* the monography of the Jasminaceæ and that of the Oleaceæ. He would have left but little to do for his successors, had not the works of Mr. Eichler and of Mr. Hooker introduced in the study of these plants new elements which we have mentioned. A few changes in the relative grouping of the various genera of Oleaceæ seem to us to be the necessary consequence of the works of these scholars. Let us add that, in order to put the systemization of the Phanerogams in unison with that of the Thallophytes, we believe with MM. Bentham and Hooker, and with Mr. Van Tieghem, in inclosing the family of Oleaceæ within narrower limits; it is expedient that there be equilibrium between the different branches of the vegetable kingdom, and that the Phanerogams do not appear, contrary to reality, to excel the aggregate of Cryptogams in the diversity of forms. These considerations deserve longer developments, which could not be given place here. We shall be able to enlarge on this subject when we shall publish, as we hope to, a more complete study on the entire group of Oleaceæ. For the present, we shall only summarize our views, modifying, as much as we deem proper, the classification adopted by Mr. De Candolle, and referring to the *Prodrome* for the general history, to which we would have to add only the works mentioned above.

The Jasminaceæ constitute, according to him, an indivisible group, of which he makes his the one hundred and twenty-eighth family. We have but to maintain this simple notion as to Jasminaceæ.

We shall consider them as the first tribe of the Oleaceæ.

The tribe of Oleineæ (one hundred and twenty-seventh family of Mr. A. De Candolle) divided by the author of the monography of the *Prodrome* into four tribes, necessitates, it seems to us, a few changes, based above all on the researches of Mr. Eichler and of Mr. Hooker.

We believe the number of the subdivisions should be reduced to three, the *Noronhea* and *Ceranthus* and directly allied to the Oleeæ through the Eu-Loniciera, which possesses, like the Oleeæ, a fleshy cartilaginous albumen. The Chinonantheæ unite in the same manner with the Oleeæ; but the absence of albumen brings a few representatives of this little group nearer to the Jasminaceæ. We shall then place at the head of the series of Oleineæ the sub-tribe of *Olseæ;* the *Syringa* will take place between them and the Fraxineæ, which, by the aggregate of their characters, wander much more from the primitive type. The Salvadoraceæ will form the third tribe; their study is unfortunately too incomplete yet to allow us to give a more positive character to what we know of them.

The notes which we give below in table form will summarize our views better than all explanations.

OLEACEÆ.

Trib. I. *Jasminaceæ.* No albumen.

Trib. II. *Oleineæ* (Oleaceæ, D. C.).

Sub. trib. I. *Olseæ.* Fruit fleshy, drupaceous (of the form of a drupe) or bacciform (of the form of a berry); indehiscent (not opening spontaneously at maturity); two ovules in each cell, laterally fixed near the summit; seeds single by abortion of three ovules, rarely two, in each cell. Seed albuminous with superior radicle; inflorescence paniculate trichotomous (divided into threes) or fasciculate (growing in bundles), with centripetal primary branches, the later ones sometimes centrifugal.

The fruit is a drupe.

A. Seeds devoid of albumen at maturity.

Noronhea, *Ceranthus.*

B. Seeds albuminous at maturity.

α. Corolla developed.

Linociera, *Notelaea*, *Osmanthus*, *Phillyrea*, *Chionanthus*, *Olea* (pro parte—in part).

B. Corolla nearly always wanting or reduced.

Olea (pro parte), *Forestiera.*

The fruit is a berry of one fourth seeds.

Myxopyrum, *Ligustrum.*

Sub. trib. II. *Syringeæ.* Flowers hermaphrodite with tubular corolla; fruit dry, capsular, of loculicidal dehiscence (opening through the back of the cells); ovules suspended at the top of each cell; seeds winged, suspended with superior radicle.

Syringa, *Forsythia*, *Schrebera* (*Nathusia* Richard).

The genus *Syringa* closely approaches the Fraxineæ by its ovules to the number of two in each cell, and its corolla of induplicate (having the edges bent abruptly toward the axis) valvate æstivation; the *Schrebera* have 3–4 ovules in each cell; the *Forsythia* have 4–10; but, while all the preceding genera have seeds with abundant albumen, the embryo of the *Schrebera* has consumed the albumen at the time the seed is ripe.

Sub-trib. III. *Fraxineæ.* Fruit samaroid (resembling a samara), bilocular (two-celled), indehiscent, winged; calyx wanting at times; flowers polygamous and apetalous.

(Fraxinus sect. Fraxinaster); dipetalous or tetrapetalous. (Fraxinus sect. Ornus); coralla of induplicate valvate æstivation. Two ovules suspended at the top of each cell; seeds compressed, flattened, albuminous, with superior radicle (position necessarily determined by the form and position of the ovule); inflorescence ramous centripetal, with branches bunched in fascicles more or less condensed at the nodes.

Fraxinus, *Fontanesia.*

The genus Fontanesia Labillardiere constitutes a natural tie between the Fraxineæ and the Syringeæ. The fruit, truly enough, is a bilocular capsule, as in Syringeæ, but an indehiscent capsule surrounded by a narrow wing. Its seeds are most often single in each cell, as in the *Fraxinus.*

Trib. III. Salvadoraceæ.*

Flowers formed of four sepals, of four petals, of four introrse stamens, of two carpels, capped by a very short style, terminated in a bilobed (two-lobed) stigma; in each cell two collateral and ascending ovules; berry, uni or binocular; albumen wanting; leaves provided with very small filiform stipules.

---

* Vesque, Ann. des Sc. Natur. Botan. I., 1885, 7th ser.

* Planchon, Ann. des Sc. Natur. Botan., 1889, 3d ser.

Salvadora, Azyma, Dobera.

The Oleaceæ belong generally to the temperate and warm part of the old continent. Abundant in the Mediterranean region of Europe, they extend, in a general way, throughout the temperate zone of the Asiatic continent and reach their maximum of extension in China and Japan. A few species reach the neighborhood of the boreal region (*Fraxinus*); a few others extend as far as the Indies, Australia, and the Malayan Archipelago (*Ligustrum*). The Olive genus is spread mostly on the Asiatic continent, but it occasionally extends beyond the limits of the family in the warm and temperate regions of both hemispheres. A single species, however, the *Olea americana*, is spread in Florida, Georgia, and South Carolina. *Olea laurifolia* is found in Abyssinia and as far as the Cape of Good Hope. Of all the Oleaceæ, the *Ligustrum* and the *Olea* have the greatest number of species.

The genus *Olea*, which we are now going to consider more specially, has been perfectly defined and characterized by Linnaeus, who placed it, as we have seen, in his Diandria Monogynia, by the side of all the plants with which the Olive presents real affinities, the Jasmines included.

Here is the diagnosis which he gives of it:* "Olea: Calye. Perianthium monophyllum tubulatum, parvum; ore quadridentato, erecto, deciduum. Coroll. monopetala, infundibuli, formis; Tubus cylindraceous, longitudine calycis; limbus quadripartitus, planus; laciniis semiovatis. Stamin. filamenta duo, opposita, subulata, brevia; antherae erectae. Pistill. Germen subrotundum; stylus simplex, brevissimus, stigma bifidum, crassinusculum, laciniis emarginatis. Semin. nux ovato-oblonga, rugosa."

[*Olea.* Calyx-Perianth (floral envelope) monophyllous (one-leaved) tubular, small; mouth quadridentate (having four teeth on the edge), erect, deciduous (falling off); corrolla monopetalous, infundibuliform (funnel-shaped; tube cylindrical, of the length of calyx; limb quadripartite (divided to the base into four parts), flat, laciniae (narrow, slender portion of the edge), semi-ovate; stamens two filaments, opposite, subulate (awl-shaped), short; anthers erect; pistill germ subrotund (almost round), style simple, very short, stigma bifid (two-cleft), thick, laciniae emarginate (notched at the summit); drupe (stone fruit) subovate, glabrous (hairless), unilocular; seed an ovate-oblong (oblong, with one end narrower than the other), wrinkled nut.]

This diagnosis, shorter by half than the one Tournefort had given of the genus *Olea*, is also much more precise, and in spite of the progress of floral morphology, it always applies exactly to this genus.

Mr. A. De Candolle† has divided the genus *Olea* in two sections, following partly what Endlicher has done.

The first section, *Gymnelaea*, has been characterized by Endlicher. To the general characters of this genus, it is sufficient to add the mention of the absence of corolla and of the *hypogynie* (insertion below the pistil) of the stamens. The section *Gymnelaea* contains, however, but one species, the *Olea apetala* Vahl (*non alienum*—none of the others).

The section *Eu-elaea* corresponds to the *Oleaster* of Endlicher; the limb of the corolla is quadrifid (four-cleft); the stamens are inserted at the base of the corolla. To this section relate the diagnosis of Linnaeus and the descriptions which most authors have since given of the Olives.

---

* Genera. Plantarum, Stockholm.

† Prodrome, 1844.

It subdivides naturally, first, in *Eu-elaea* of terminal inflorescence, for which Decaisne proposed to establish a new genus;* and, second, in *Eu-elaea* of axillary inflorescence. Among the latter, some have diœcious flowers, by abortion (*Olea dioica*, Roxburgh; *Olea americana*, L.); the others have hermaphrodite flowers. It is among the last named species that the cultivated Olive (*Olea europaea*) takes its place.

The Olive of Europe is sufficiently characterized with respect to its congenero by its leaves, oblong or lanceolate (lance shaped), very entire (not divided at the edge), mucronate (tipped abruptly by a short point) at the end, glabrous on top, white scaly beneath, with axillary branches, erect at the time of flowering, pendent when the fruit is ripe, and by its ellipsoidal drupe.

Linnaeus† already distinguished several varieties of Olive, and first of all the *Olea sativa* type of all the varieties that are cultivated, and the *Olea sylvestris* (*Oleaster*, D. C.), the wild olive of our southern plains. Before him, Magnol‡ had already distinguished twelve species of Olives belonging to the same specific type. Gouan, nearly a century later, did nothing but repeat what Magnol had said of them.

The Olive is a tree that delights in warm and dry climates; it shuns dampness and it fears nothing from the long droughts. Its place is by the side of all trees, the persistent foliage of which insures the existence in guarding a too active transpiration.

To summarize, and to immediately formulate a general idea, the Olive thrives in the Mediterranean region, conceived in its broadest sense, according to the opinion of Mr. O. Drude.‖ The learned professor from Dresden designates this region under the name of boreo-subtropical; embracing a wider scope than Grisebach had done, he considers it as intermediary between mid-Europe (woody domain of western Europe, according to Grisebach) and the tropical forests of Asia and of Africa. He divides it into four domains; the first comprises the Azores, the Canaries, and Madeira; the second, which receives the name of Atlantico-Mediterranean, embraces the whole of the Iberian Peninsula (Spain), all that part of France where the evergreen Oak thrives, the whole of Italy, Turkey, and Greece, the southern shores of the Black Sea, the coasts of Anatolia, of Syria, and of Egypt, and the whole of Algeria, the high plateaux included. The domain of the southwest of Asia is bounded north by the Caucasus and the southern shores of the Caspian Sea, by the south slope of the Himalaya; it extends to the greater part of the valley of the Indus and to the shores of the Persian Gulf. The Sahara and the north of Arabia constitute the fourth Mediterranean domain, bounded south by a line which oscillates between the fifteenth and twentieth parallels.

The Atlantico-Mediterranean domain comprises the whole of Mediterranean France. Mr. Drude extends it beyond the limits assigned to it by Grisebach, basing himself on this fact, that the evergreen Oak thrives in the valley of the Garonne, and as far as La Rochelle. All the southwest of France is then included by Mr. Drude in the Mediterranean region.

We have particularly insisted with Mr. E. Durand§ on the reasons which seem to oppose the adoption of the views of Mr. Drude. We think, on the contrary, that the Mediterranean region must be considered as bounded by the limits of culture of the Olive, and we do not hesitate in setting forth here the motives which prompt us to adopt this opinion.

---

* Monographia des Ligustrum, 1878.

† Sp. Plantarum. Vilnna., 3d edit., 1864.

‡ Hortus regius. mons peliensis., Mompel., 1697.

‖ Dic. Florenreiche der Erde. Peterman's Mitteilunden, 1884.

§ Bulletin de la Soc. Botan. de France XXXIII, 1886.

Peculiar topographical conditions interpose nearly everywhere in the south of France—a barrier between the north and the south; towards the north and west rains are never lacking in any season of the year. In the south, the summer is regularly devoid of rains; in the north and west winter alone comes and stops all vegetation for a long time. In the south the wintry rest is never complete and of short duration; but to the summer months corresponds a cessation of vegetation nearly everywhere longer and more complete than the wintry repose.

Without seeking to formulate the intimate action which such climatic differences exercise upon vegetation, and concerning which experimental physiology alone can enlighten us, we can, at least, establish this fact that three essential conditions give to the Mediterranean region its distinctive character. They are, first, the appearance, nearly exclusive of the woody species with persistent leaves; second, the predominance of perennial shrubs with persistent and often aromatic leaves; third, the considerable number of annual plants.

We have tried to bring into relief this physiognomy so special to our southern regions, and to give the notion of the vegetables to which they owe it. Just so, however, a few plants peculiar to the seashore may be seen wandering from the points directly submitted to marine influences, so it is observed that Mediterranean vegetables rise along our mountain slopes and mingle in a certain measure with the plants of the woody region. There is then a reciprocal penetration of the floras of Central and Mediterranean Europe. Where shall we find a character which will enable us to trace a limit between them?

It seems to us that the Olive answers all the conditions one may require for the determination of this limit. Insensible, or nearly so, to the chemical nature of the soil, the Olive only requires dry lands, the extremes of temperature between which it grows are also in perfect harmony with what we know of the Mediterranean flora. These various reasons have seemed so sound that many authors have given to the region of the Mediterranean Sea the name of Olive region. We do not hesitate in believing that this tree can, all around our great interior basin, serve to characterize the Atlantico-Mediterranean domain. It is at least the result pointed at by the observations we have been able to make.

Now, we know that owing to the important place it fills in the alimentation of the south, the Olive is cultivated in France wherever the climate allows it; wherever can be expected from it, not a return commercially remunerative, but only the products necessary to the daily alimentation; it is then possible to trace the limit of culture of the Olive without interruptions or gaps. It seems as though the valleys of the Oriental Pyrenees and of the Aude were cut by a horizontal plane following a mean altitude varying between three hundred and four hundred meters. Below this level there is not a vale, not a ravine, where the Olive is not cultivated. Above, it exists nowhere. Often stopped by a solid mass of mountains, the Olive has penetrated with agriculture in all the valleys, without ever being restricted by any other cause than impossibility of culture. One may remark the way it goes up the valleys of the Jaur, towards Saint Pons, of the Orb, to beyond Lunas, the Herault, the Gardon, and notably the Ardeche and its tributaries, the Durance and its lateral valleys. It blossoms largely in the hollow which forms the entrance to Castelnaudary, and in the valley of the Rhone, on the left side of which it stops opposite Viviers, while on the right side it extends as far as Rochemaure, eight miles further north. In short, we can say that the Olive essentially characterizes the Mediterranean region, and that it thrives wherever the conditions peculiar to that region present themselves.

If we go further up the mountains, we observe, without difficulty, that the Olive does not reach the same height in the spurs of the Pyrenees as in the Maritime Alps, and if we consult the data acquired by a great number of observers, we shall easily find out the nature and amplitude of these differences. Perhaps, also, shall we be able to ascertain their causes.

Without going outside our French Mediterranean domain and beginning west, we know that the mean limit of the culture of the Olive is very limited in the Oriental Pyrenees. In Aude the culture of the Olive would not exceed forty odd feet. In Herault, and in Bouches-du-Rhone, it reaches one hundred and ten feet. It is interesting to note that east of the Rhone the superior limit of the culture of the Olive rises considerably. There are some very thriving Olives at an altitude of two hundred and twenty-two feet on the southern slope of the Luberon and of the Ventoux. It reaches two hundred and fifty feet in the neighborhood of Castellane, and two hundred and eighty feet on the southern slopes of the Maritime Alps. These differences are very important, it must be acknowledged, if we consider the whole of the Mediterranean region from west to east; if even we confine ourselves to the western basin of the Mediterraenan Sea. In Portugal, we find it in the mountains of the Algarve at four hundred and fifty-four meters (Bonnet), but it is admitted that the Olive does not arrive at its normal dimensions above eighty-two feet in that region. In the Sierra Nevada Boissier has noticed it as far up as three hundred and ten feet, and even as far up as four hundred and thirty-five feet in favorable situations.

It reaches two hundred and fifty feet in the Balearic Islands (Mares and Vigineix), slightly higher on the Etna (Gemellaro), two hundred and thirty-five feet in Cilicia (Unger and Kotschy), two hundred and twenty feet in the Island of Cyprus, three hundred and thirty-five feet at Granada, and higher still in the province of Algiers.

These observations, we believe, can be summarized in admitting that the altitudinal limit of the Olive reaches its maximum where the climatic characters of the Mediterranean Sea reach their maximum. It lowers towards the Orient, where the winters become severe; it sinks down much more yet on the coast of Portugal, to get up again on the other side of the mountains, which stop the greater part of the aqueous precipitations and give to the mountains of the interior of Spain their special climatic character.

The limit in height seems then determined, as well as the limit in latitude, by the increase of humidity at the same time as by the lowering of the wintry temperatures. From that comes, undoubtedly, the astonishing difference presented in this respect by Nice and Florence, Venice and the Illyrian coast, along which the Olive reaches 46 degrees of latitude. This may account, also, for the fact that in the west of Europe the Olive hardly exceeds 44, while towards the east it reaches 45 degrees.

VI.

CHEMICAL STUDY OF THE OLIVE.

This scientific study has directed the attention of chemists of late years. Among these, Mr. Louis Paparelli, a scientific chemist of the National Academy of France, carried on a very extended investigation, the summary of which is here given, consisting of a complete analysis of the soil, of the ashes from the wood and leaves, and the fruit; also an estimation of the tannin in the bark, and the relation between the soil and plant.

The samples which were used in making this study are as follows:

(*a*) Soil;
(*b*) Olive wood (large and small branches);
(*c*) Leaves;
(*d*) Olives;
(*e*) Oil cakes.

They were submitted to a very careful chemical examination, as will be seen later, in the studies hereinafter set forth.

COMPLETE ANALYSIS OF THE SOIL.

As long as the soil has been looked upon as a mere support for the plant, the chemical analysis has been much neglected, so that for a long time the physical state of the earth has been considered as the only condition capable of producing any effect upon vegetation. To-day, however, the chemical composition of the soil in the production of good crops is very important to the grower.

The simple examination of the physical state of the soil, although of paramount importance from an agricultural standpoint, never would suffice to apprise us of the qualities of the land, with respect to the vegetables one may want to grow on it.

On the other hand, chemical analysis alone cannot successfully solve all agricultural problems; but when made under certain conditions, it enlightens us on many subjects which, without it, would remain wholly unknown.

Thus, as has been briefly indicated by M. Grandeau, in his lessons at the Faculty of Sciences, the analysis of a soil can impart us useful information on the following points:

(*a*) Relative quantities of the assimilable principles and composition of the soil reserve.

(*b*) Determination of the nutritive elements wanting in the soil; nature of the aliments to introduce.

(*c*) Impending causes of sterility in arable lands; absolutely, or as to this or that crop.

So that, to find an average as to the degree of fertility of a soil, it is necessary to make the three following determinations:

First—Mechanical analysis.
Second—Physico-chemical analysis.
Third—Chemical analysis of the fine earth.

These determinations will surely enable us to guide the husbandman in his undertakings.

The samples of earth here analyzed were taken from different points of the soil and around the main roots of the plant, in order to obtain an average as precise as possible.

Before proceeding with any determination, the earth was laid out in the open air, and stirred from time to time so as to make it lose the greater part of its hygrometrical water (moisture).

Three analyses of the earth, the results of which are given below, were made according to the excellent methods by M. Grandeau, in his *Traité d' analyse des matières agricoles:*

Mechanical Analysis.

Fine earth	93.50
Calcareous (limy) stones	5.30
Siliceous (flinty) stones	1.20
	100.00

Physico-chemical Analysis.

Water	2.000
Sand	72.000
Limestone	12.037
Clay	12.050
Humus	0.140
Organic debris	1.773
	100.000

Chemical Analysis.

Insoluble residue (silica and silicates)	75.2000
Phosphoric acid	0.2752
Peroxide of iron and alumina	6.8000
Lime	6.8400
Magnesia	0.0800
Sal soda	0.0191
Potash	0.1544
Water	2.0000
Organic matter (azote, 0.1435)	3.0000
Sulphuric acid	0.0206
Carbonic acid	5.5400
Chlorine	0.0018
	99.9311

Casting a glance over the preceding tables, one can form an exact idea of the nature of the land. It falls into the group of silico-argilo-calcareous (flinty-clayey-limy) lands. Were we to believe, absolutely, certain authors, who have written that olives grow and bear on the most barren ground, and consequently that all manuring has to be dispensed with, we should consider that soil as too good for olive culture.

Before advancing such ideas, however, one should remember that, as a matter of fact, the seaside pine alone can vegetate in an almost sterile sand, and we must affirm that a completely barren soil will never suffice for the life of any plant, even the least exacting.

I will repeat, in this connection, the words of a person very competent in this matter, namely, Professor G. Caruso, of the University of Pisa. "The olive," he says, "likes a permeable and moderately damp soil; permeable, so that it may spread and grow deeper roots; rather damp, so that it may last and withstand aridity and dryness."

As to that, all lands suit it, except those exceedingly dry, or compact, or too humid.

It is not true, then, that the olive thrives in all lands, and that it prefers those of inferior quality, as a few agriculturists have said.

On the contrary, we may be sure that it is not at all advantageous for the farmer to reserve the most sterile lands for his olives; the quantity of fruit reaped will always be extremely small, and the oil extracted therefrom could not be but very inferior in quality to that obtained from olives well cared for.

Thus we recognize the soil analyzed as one nearly propitious to olive culture, but it could be considerably improved, and, therefore, better suited to that culture, were it plentifully manured with fertilizers rich chiefly in potash, it being acknowledged since a long time that this tree is a great feeder on potash, which, in fact, is found in great quantities in the formation of its wood, leaves, and fruit.

We shall return later on to the rational manuring of the olive.

ANALYSIS OF THE ASHES OF THE WOOD, THE LEAVES, AND THE FRUITS OF THE OLIVE.

The wood, the leaves, and the fruits were incinerated separately, and under a determined weight, in a gas muffle, they having been first desiccated in a hot-air bath. Very white ashes were had.

For the analysis of the ashes, the method of Schloesing is followed, which is preferable to any other method yet offered for the measurement of the constituting principles of vegetable ashes.

A determined weight of ashes was attacked by nitric acid in a platinum capsule, and evaporated until dry in a sand bath, to render the silica insoluble.

No more acid vapors being emitted, this was taken up and digested (softened) with some nitrate of ammonia and heated anew, care being taken not to vaporize all the nitrate.

We then added a small quantity of nitric acid to dissolve all the iron, poured off gently on a filter, and washed.

The *silica* and the *sand* remaining on the filter were calcined and weighed. This was thrown into boiling carbonate of soda, which dissolved the silica and left the sand intact, and then filtered, washed, calcined, and weighed, the amount of silica being calculated by difference.

The *iron* was measured in the state of phosphate. A given volume of the azotic liquor was saturated with ammonia, heated, and augmented by acetate of ammonia. The precipitate of phosphate of iron was filtered, washed with hot acetic water, calcined, and weighed. In this manner were obtained all the iron and part of the *phosphoric* acid. As it was desired to measure the latter body at the same time, the remainder of the phosphoric acid was immediately precipitated in the filtered liquor, with the aid of acetate of iron.

The two precipitates were mixed together and dissolved in hydrochloric acid; the iron was separated, and the phosphoric acid directly measured through the means of molybdate of ammonia.

The *sulphuric acid* was measured in the state of sulphate of baryta.

The *carbonic acid* was determined directly by weighing, with one of the many apparatus devised for this measurement.

The *lime*, precipitated by oxalate of ammonia, was weighed in the state of oxide.

The *potash* was measured in the state of chloro-platinate, and the *soda* estimated by difference.

The *chlorine* was determined by a standard solution of nitrate of silver.

In the weight of the *magnesia* is included that of the *sesquioxide of manganese*, this body being in too small a quantity to be separated.

Before presenting the results of the analysis of the ashes, we will show in the following tables the proportions of *water* and *dry substance* of the different samples, and afterwards the rate of *ashes*, per cent of original matter, and per cent of dry substance:

	Wood.		Leaves.	Fruits.
	Large Branches.	Small Branches.		
Determinations made—				
Water	14.50	18.75	42.40	52.60
Dry substance	85.50	81.25	57.60	47.40
Totals	100.00	100.00	100.00	100.00

Rate of Ashes.

	Wood.		Leaves.	Fruits.
	Large Branches.	Small Branches.		
Per cent of original matter	0.9405	0.9625	2.5056	1.4220
Per cent of dry substance	1.1000	1.1400	4.3500	3.0000

The ashes thus obtained were analyzed and gave the following results:

Composition of the Ashes of the Wood, the Leaves, and the Fruits of the Olive.

	Sand	Carbonic Acid	Potash	Soda	Lime	Magnesia	Peroxide of Iron	Phosphoric Acid	Sulphuric Acid	Silicic Acid	Chlorine
Wood:											
Large branches	3.300	7.791	19.165	2.250	57.574	3.652	3.275	11.684	2.119	0.281	traces
Small branches	2.000	9.100	20.492	4.778	50.412	6.760	3.284	12.437	1.160	0.677	traces
Leaves	3.525	1.870	30.260	1.614	46.155	4.424	1.414	10.470	4.754	0.649	0.260
Fruits	1.600	8.493	60.744	2.225	16.282	3.770	0.096	8.334	1.104	5.670	1.581

As a complement to the analysis, the *azote* was measured in the wood and leaves, and, subsequently, the estimation of the azotized matters of the fruits was made at the time of the immediate analysis of the latter.

For the wood and leaves the rate of azote has thus been portioned out:

		Per Cent of Original Matter.	Per Cent of Dry Substance.
Wood	Large branches	0.8813	1.0308
	Small branches	0.8973	1.1044
Leaves		0.9117	1.5829

From this data may be clearly seen that the olive is a tree very rich in potash, and not less so in lime and in phosphoric acid. These figures may vary within a certain limit, owing to the variety of olive operated upon, to the nature of the soil in which it has grown, and to other special conditions of culture and climate.

It is indispensable beyond doubt, however, that these predominating elements be found in great quantity in the manure, if one wants to increase the fruitfulness of the olive, or maintain it if already good.

MEASUREMENT OF THE TANNIN IN THE OLIVE BARK.

Although the measurement of the tannin in the olive bark may not perhaps have any practical application, the determination was made in order to find out what the rate would be, as compared with that of other trees, and especially that of the oak, the bark of which is much used in the tannery.

To this end, we pounded the bark of an olive branch of about 3.9 inches in diameter, and took .42+.02 desiccated matter. This was exhausted in a boiling waterbath until cessation of reaction by perchloride of iron, and diluted.

In this the tannin was measured by the method of Lowenthal-Neubauer, and the result was:

Tannin and other oxidizable matters	3.44
Pure tannin after separation through hide powder	0.97

In an oak branch of about 3½ inches in diameter, the bark of which is used in tanning, 3 per cent of tannin was found; so that one may infer that in the olive bark there was about one third as much tannin as the oak bark contained.

IMMEDIATE ANALYSIS OF OLIVES.

The immediate analysis of olives has been the object of many studies which have caused endless discussions, especially in regard to the quantity of fatty substances (oil) contained in the various constituting parts of the olive drupe.

The results which we have obtained have convinced us once more that they are very variable, owing to the many conditions which provoke this variability.

We began by separating the different parts of the drupe: the *pulp* (epicarp, *skin*, and sarcocarp, *flesh*), the wood of the *pit* (endocarp), and the *kernel*.

While making this operation, account was kept of their weight in the total formation of the drupe, and afterwards was determined the quantity of water contained in the whole drupe and in each of its constituting parts.

Seven ounces of olives contained 1.402 of stones (endocarp and kernel) and 5.602 of pulp, which makes 19.5 per cent of stones and 80.5 per cent of pulp; 8.8 ounces of olives put into the hot air bath till cessation of loss in weight gave 4.202 of dry substance, and lost 4.602 of water, which makes 52.6 per cent of water and 47.4 per cent of dry substance.

In the same manner 3.502 of pulp left 1.402 of dry substance, and lost 2.1 ounces of water; 1.4 ounces of stones (endocarp) lost .28 ounce of water, and left 1 ounce of dry substance, which makes 23 per cent of water and 77 per cent of dry substance; .7 ounce of kernels lost .17 ounce of water, and left .53 ounce of dry substance; hence, 27 per cent of water and 73 per cent of dry substance.

We will now present these figures in table form to better show the results:

	Whole Drupe.	Pulp.	Endocarp.	Kernel.
Water	52.60	58.00	23.00	27.00
Dry substance	47.40	42.00	77.00	73.00
	100.00	100.00	100.00	100.00

The difference between the total water of the drupe and that contained in its three composing parts, is due to the fact that when the water is determined in the whole drupe, the water of the endocarp and of the kernel, being unable to evaporate, remains imprisoned in the drupe itself.

PULP ANALYSIS.

Twenty grams of pulp desiccated at 212 degrees Fahrenheit, were exhausted by sulphide of carbon in the Schloesing apparatus, and gave .44 ounce of *fatty substance*, and .24 ounce of residue; hence, 66 per cent of oil calculated for the dry substance, and 27.62 per cent reckoned for the original matter.

In .03 ounce of residue obtained after extraction of the oil, the *azote* was measured by the method of sodic lime. The measurement gave 0.43 per cent of azote of dry substance, and 0.18 per cent of original matter. Multiplying these figures by the factor 6.25 we had:

Azotized matter, per cent of dry substance	2.668
Azotized matter, per cent of original matter	1.120

In .07 ounce of residue after extraction of the fatty substance, we made the measurement of the *cellulose* (woody or coarse cellulose) according to the method of Weende.

We obtained 0.317 of cellulose in the .07 ounce; which makes 2.263 of cellulose per cent of original matter, and 5.389 per cent of dry substance.

Under the name of *organic matter* was included that outside the water and the fatty matter, already measured separately.

7.05 ounces of pulp incinerated left .1 ounce of *ashes;* that is to say 1.7 per cent of original mattter, and 4.047 per cent of dry substance.

Here is a complete synopsis of the pulp analysis:

Bodies Measured.	Per Cent of Original Matter.		Per Cent of Dry Substance.	
Water	58.000		--------	
Fatty substance	27.620		66.000	
Azotized matter		1.120		2.668
Organic matter	12.680		29.953	
Cellulose		2.263		5.389
Ashes	1.700		4.047	
	100.000		100.000	

ANALYSIS OF THE ENDOCARP.

The stones separated from the pulp were washed several times, even in warm water, and rubbed with bibulous paper; then they were washed again in weak alkaline water, and lastly in distilled water, to take off all trace of oil coming from the pulp.

This being done, they were broken and separated from the kernel and finally pulverized.

.35 of an ounce of the powder was taken and exhausted with sulphide of carbon, in the way indicated for the pulp.

At the end of several days distillation .017 ounce of oil was obtained. That oil was of a yellowish, nearly rusty-red color, and very thick.

The rate per cent is 4.55 for the dry substance and 3.503 for the original matter.

The other measurements were made in the same manner as for the pulp. Thus we measured the azote in 5 grams of well pulverized matter, and had .22082 grams per cent of azote, corresponding to 1.380 of azotized matter, per cent of dry substance, and to 1.062 per cent of original matter.

For the measurement of the cellulose we took .07 ounce, which gave .01 ounce, or else 44.750 of cellulose, per cent of dry substance, and 34.457 per cent of original matter.

Seven tenths ounce of incinerated stones (the wood) gave .03 ounce of ashes; hence, 0.53 per cent of original matter and 0.689 per cent of dry substance.

The following table will give a better idea of the results of this analysis:

Bodies Measured.	Per Cent of Original Matter.		Per Cent of Dry Substance.	
Water	23.000		----------	
Fatty substance	3.503		4.550	
Azotized matter		1.062		1.380
Organic matter	72.967		94.761	
Cellulose		34.457		44.750
Ashes	0.530		0.689	
	100.000		100.000	

ANALYSIS OF THE KERNEL.

The measurements were made by the same method as for the two preceding analyses.

From .07 ounce of matter* were obtained .016 ounce of fatty substance, that is to say, 21.6 of oil, per cent of original matter, and 29.589 per cent of dry substance.

.035 ounce of matter contained 0.03 of azote, corresponding to 19.03 of azotized substances, per cent of dry matter, and 13.89 per cent of original matter.

.035 ounce of matter contained .008 ounce of cellulose, or else 22 of cellulose, per cent of dry substance, and 16.06 per cent of original matter.

.176 ounce of fresh incinerated kernels left .0035 ounce of ashes, that is to say, 1.20 per cent, corresponding to 1.643 per cent of dry substance.

The oil from the kernel had a very pronounced smell of cinnamon. It has not been possible to make more precise studies in this relation; one should have had a greater quantity of matter at his disposal to be able to study this new substance. It is very singular, however, that Mr. Mingioli has found the same substance in the endocarp (inner coat or layer) of the olive drupe, rather than in the kernel. We hope that further studies will enlighten us in this respect.

We give, in the following table, the results of this analysis, and in another a general synopsis of the immediate analysis of the whole drupe:

Bodies Measured.	Percentage of Original Matter.		Percentage of Dry Substance.	
Water	27.000		----------	
Fatty substance	21.600		29.589	
Azotized matter		13.891		19.030
Organic matter	50.200		68.768	
Cellulose		16.060		22.000
Ashes	1.200		1.643	
	100.000		100.000	

---

* It must be borne in mind that we operated on matter desiccated at 100 degrees.

Synoptic Table of the Immediate Analysis of the Olive Drupe.

Bodies Measured.	Pulp.		Endocarp.		Kernel.	
	Per Cent of Original Matter.	Per Cent of Dry Substance.	Per Cent of Original Matter.	Per Cent of Dry Substance.	Per Cent of Original Matter.	Per Cent of Dry Substance.
Water	58.000	----------	23.000	----------	27.000	----------
Fatty substance	27.620	66.000	3.503	4.550	21.600	29.589
Organic matter	12.680	29.953	72.967	94.761	50.200	68.768
Ashes	1.700	4.047	0.530	0.689	1.200	1.643
	100.000	100.000	100.000	100.000	100.000	100.000
Azotized matter	1.120	2.668	1.062	1.380	13.891	19.030
Cellulose	2.263	5.389	34.457	44.750	16.060	22.000

RELATIONS BETWEEN SOIL AND PLANT.

Modes of Absorption of the Mineral Principles of the Soil by the Roots of Plants.

The main factor of agriculture is manuring. On it depends the intensity of the development and the weight of the crop which plants furnish. Plants are constituted of thirteen to fourteen mineral substances, most of four or five, and only three in the greater number of cases need be looked after by the husbandman, to increase and maintain the fertility of his lands.

To form their tissues, and go through all the phases of their existence, plants need four oxides (potash, lime, magnesia, and oxide of iron), one neutral body (water), and four acids (carbonic, sulphuric, phosphoric, and nitric), for the absence of a single one of these bodies or their elements would render vegetation impossible.

On the other hand, these nine bodies suffice for the development of the plant. The vegetable tissues contain still other bodies which are not indispensable to vegetation, namely: chlorine, manganese, soda, and silica.

As stated above, three only suffice for cultivation in ordinary cases; they are: azote, potash, and phosphoric acid, principles which must be plentifully restored to the soil, as they are taken off almost completely by the crops.

We have seen, in the analysis of the olive, what enormous quantities of potash are found in the tissues of the wood, leaves, and fruits of this tree; quite as large quantities of azote and phosphoric acid contribute to its reconstitution; hence, follows that these principles must be restored to the soil in quantities large enough to maintain the stability of the earth's fecundity, and increase its yield. As to the other bodies, such as the magnesia and lime, the restitution is not absolutely necessary, provided one be sure that these bodies exist in the soil in sufficient quantity, by finding them in abundance, especially the lime, in the wood and leaves of the olive. The restitution also of the carbon, iron, silica, chlorine, sulphur, is not necessary; the air contains enough carbonic acid and the soil is sufficiently supplied with the four last named bodies.

Although we have said to manure abundantly in consideration of the large quantities of the three essential elements constituting the plant, too much dressing must not be given to the soil, however, as only part of the fertilizing principles are utilized by the plant.

We will now briefly outline how these principles are assimilated by the plants; that is to say, how their absorption takes place.

After the admirable discoveries of Huxtable, Thomson, and Way about the absorbing power of the soil, and those of the dialytic phenomena by Graham, the until then accepted ideas on the mode of nutrition of plants had to fall down completely. It had been believed for a long time, and, unfortunately, a few people believe it yet to-day, that plants cannot feed unless the roots find in the soil materials in solution which can be absorbed by the rootlets.

It was then supposed that the plant meets in the soil quantities of water sufficient to dissolve the materials necessary to its alimentation. Thus the rootlets would have absorbed these principles by a process quite analogous to that produced by the elevation of the liquid in the capillary tubes. This theory is utterly false, and therefore has no reason to exist any longer.

The absorbing power of the soil suffices to prove it. M. Schloesing, in France, has demonstrated, through very precise and most important experiments, that the liquid moistening the soil contains traces only of nutritive principles, and that it would not be possible to explain in this way the development of the plant.

It was asked then how the nutrition of plants is effected, if the liquid contained in the soil does not possess enough fertilizing principles.

This is exactly what the discoveries of Graham, Zoeller, and others have demonstrated. The internal liquid of the plant roots being acid, is capable, owing to this acidity, of dissolving certain substances, especially the phosphates which come in contact with the outer covering of the root.

It is through dialysis that the nutritive salts of the soil penetrate into plants; there is then no intervention on the part of the liquid moistening the soil. From that may be judged of what importance, with respect to nourishment, is the dissemination of the manure, to multiply the points of contact between the roots and the nutritive material.

The more thoroughly the manure is mixed with the earth, the more will the plant feed, and consequently the heavier will be the crop.

WHAT AN OLIVE CAN PRODUCE IN WOOD, LEAVES, AND FRUIT, YEARLY.

From several observations made in different parts of Italy where the olive is cultivated, it results that a large, robust olive, well cared for in a soil suited to its development, yields from one hundred and thirty to one hundred and forty pounds of wood and leaves in a dry state, and every year from fifteen to twenty-five pounds, and sometimes much more, of fresh fruits.

From that can be calculated, with the aid of our analyses, the quantity of materials yearly taken off by this plant from the land which feeds it.

The following table indicates the different rates:

	Potash	Azote	Phosphoric Acid	Lime	Soda	Magnesia	Oxide of Iron	Sulphuric Acid	Silicic Acid	Chlorine
Wood—kil.	0.1110	0.5338	0.0675	0.3023	0.0196	0.0291	0.0183	0.0092	0.0027	......
Leaves—kil.	0.2633	0.3166	0.0911	0.4016	0.0141	0.0385	0.0124	0.0414	0.0037	0.0023
Fruits—kil.	0.0854	0.0584	0.0118	0.0232	0.0032	0.0054	0.00014	0.00015	0.8062	0.0023

These calculations are based upon an average of one hundred and fifty-four pounds as the yearly production in wood and leaves, considering the wood as weighing one hundred and ten pounds and the leaves forty-four pounds.

The average of twenty-two pounds of fresh olives represents 4.74 of dry olives.

With the aid of these figures one can calculate the quantity of fertilizing principles absorbed every year by the trees cultivated in about two and one half acres of land; but, as the number of trees to the acre varies from one country to the other, we have abstained from making these calculations, as it would be impossible to obtain accurate figures.

ANALYSIS OF THE OIL CAKES.

Our studies were made upon oil cakes coming out of an iron press, and resulting from the pressure of whole olives.

The analytic methods followed were the same as for the immediate analysis of the olives and the analysis of the vegetable ashes.

Here are the results obtained:

Composition of the Ashes.

Silicic acid	26.190
Potash	28.942
Soda	5.279
Lime	22.953
Magnesia	1.121
Oxide of iron	4.406
Phosphoric acid	9.447
Sulphuric acid	1.594
Chlorine	0.068
	100.000

Immediate Analysis.

	Percentage of Original Matter.	Percentage of Dry Substance.
Water	12.000	....
Azotized matter	9.717	11.043
Fatty substance	11.457	13.020
Non-azotized matter	27.678	31.451
Cellulose	37.048	42.100
Ashes	2.100	2.386
Total	100.000	100.000

From these results may be seen how the oil cakes are valuable beyond all doubt. The composition of their ashes and their richness in immediate principles render them an excellent dressing and a no less valuable feed for live stock.

STUDIES COMPARED WITH THE RESEARCHES OF OTHER AUTHORS AND CONCLUSIONS.

We shall gather in several tables the results obtained by various authors, care being taken to interpose the observations which will be deemed necessary.

*Comparative Table of the Analysis of the Ashes from the various parts of the Olive.**

Bodies Measured.	Muller.			Bechi.			Audoynaud.		
	Wood.	Leaves.	Fruits.	Wood.	Leaves.	Fruits.	Wood.	Leaves.	Fruits.
Potash	21.23	26.27	60.07	20.940	10.990	72.482	14.100	14.950	20.000
Soda	--------	--------	--------	2.900	1.520	6.825	--------	--------	------
Magnesia	2.31	5.18	4.38	6.240	5.020	0.278	--------	--------	------
Lime	63.02	56.18	15.72	38.720	52.820	8.643	35.250	29.100	------
Oxide of iron	0.74	0.57	1.19	2.110	2.500	0.704	--------	--------	------
Phosphoric acid	5.42	3.74	8.35	11.590	13.650	7.624	4.100	5.900	7.223
Sulphuric acid	3.09	3.01	1.19	2.110	0.760	1.155	--------	--------	------
Silicic acid	3.82	3.75	5.58	14.230	11.370	0.685	--------	--------	------
Chlorine	0.48	1.31	4.55	0.560	0.190	1.575	--------	--------	------

Bodies Measured.	Schaedler.			Paparelli.		
	Wood.	Leaves.	Fruits.	Wood.	Leaves.	Fruits.
Potash	--------	--------	64.592	19.828	30.260	60.774
Soda	--------	--------	7.000	3.514	1.614	2.225
Magnesia	--------	--------	0.300	5.206	4.424	3.770
Lime	--------	--------	8.293	53.993	46.155	16.282
Oxide of iron	--------	--------	0.855	3.279	1.414	0.096
Phosphoric acid	--------	--------	10.805	12.060	10.470	8.334
Sulphuric acid	--------	--------	2.295	1.639	4.754	1.104
Silicic acid	--------	--------	1.200	0.479	0.649	5.670
Chlorine	--------	--------	2.519	traces.	0.260	1.581

Let us add to the analysis of the preceding table, another analysis by MM. Malaguti and Durocher:

Ingredients.	Wood.	Leaves.	Fruits.
Potash	25.54	26.67	7.13
Soda	--------	--------	20.51
Magnesia	7.23	7.31	10.25
Lime	20.12	21.93	22.91
Phosphoric acid	10.15	7.98	10.53
Sulphuric acid	3.43	1.64	4.60
Silicic acid	13.75	20.88	12.41
Oxide of iron and manganese	4.43	6.11	2.59
Chloride of sodium	12.16	5.39	7.92
Chloride of potassium	1.26	2.37	--------
Totals	98.07	100.28	98.85

This analysis was made at the same epoch as that by Müller (from 1840 to 1850) and, as may be seen, it is not the most exact.

We do not know how the authors have operated, nor what kind of samples they have used, but the rate of 20.51 per cent of *soda* in the olives is not admissible, for marine plants alone contain such a large quantity of soda.

On the other hand, we suppose that the other authors have, like ourself, measured the soda by difference, as is generally done, there being no rigorous method yet to measure in a short time the soda in vegetable ashes.

---

*To better compare the results, the figures given by the other authors have been computed with 100 as a base.

This method by difference is somewhat inaccurate, since the quantity of soda obtained is not formed wholly of this body, but also partly out of other bodies. Thus we are led to think that in the quantity of soda found by MM. Durocher and Malaguti, part is potash, seeing that they have found but 7.13 per cent of the latter body in the ashes of the olives, whereas these contain the greatest part of the potash.

It may be seen, too, that the same authors have found 12.16 per cent of *chloride of sodium* (common salt) in the wood, 5.39 in the leaves, and 7.92 in the fruits, which corresponds to 6.4448 of soda in the wood, to 2.8567 in the leaves, and to 4.1976 in the fruits. Thus, while for the wood and leaves the quantity of soda varies within the same limits as the measures obtained by the others, it would seem to increase notably in the fruits, so much so as to reach a total of 24.7076 per cent.

Not a single analysis made after that of Messrs. Malaguti and Durocher has given similar or approximate results; in fact, taking the average of the figures furnished by the other authors, we find 5.37 per cent of soda in the olives.

The proportions of the other bodies cannot be compared either, for although they may vary when operating upon different varieties of olive, and under divers conditions of climate, soil, and culture, they are too far from our results and those obtained by the others; and, therefore, the analysis does not show any importance for our purpose.

The analysis made by Dr. Müller is not satisfactory from an agricultural standpoint; it lacks data from which to draw practical applications, such as the cultivation and composition of the soil, and also the variety of the olive and its special conditions of cultivation. He has not measured the soda; however, his results are somewhat nearer to ours.

The learned Professor Bechi, Director of the Agronomical Station of Florence, has given us the most complete analysis of the olive. He not only measured the composition of the ashes of the different parts of the olive, but also made one of the most careful elementary organic analysis. We must say in this connection, that the measurement of the *azote* has a great importance with respect to manuring.

He found 1.650 per cent of azote in the wood, 2.110 in the leaves, 1.180 in the pulp, 1.570 in the stones (endocarps), 2.980 in the kernels. We had, on the other hand, 1.676 per cent in the wood, 1.568 in the leaves, 0.427 in the pulp, 0.221 in the stones, 3.045 in the kernels.

As may be seen, our results do not tally exactly with those of the learned chemist, but this is due chiefly to the very small quantity of azote found in our soil and to the defective manuring given to the olives in Matium.

It also appears clearly that the greatest quantity of azote is met with in the kernel, that which the pulp and endocarp can give being very feeble.

As to the quantity of *potash*, which M. Bechi sets down at 10.990 per cent in the leaves, and which we find to be 30.260 per cent, it must be considered that he used, in his analysis, old leaves, which always contain less potash, while the young ones hold always large quantities of it. Hence such a great difference, we having used young leaves.

For the *lime* the contrary takes place; in fact, while M. Bechi finds 52.820 per cent of that body in his old leaves, we find but 46.155 per cent in the young.

As to the *phosphoric acid* the differences are not very notable, and they are due always to the nature of the soil, to the manure, and also to the variety of olive operated upon, and also, to a great extent, to the time at which the samples have been gathered.

Having noticed the differences existing between the quantities of azote, phosphoric acid, potash, and lime, we think it useless to compare the rates of the other bodies measured, because as has been previously said, the four above cited bodies form the basis of vegetable nutrition, and must never be wanting in the soil, and especially the azote must be restored to the ground, leaving out of consideration that the leaves may draw the greater part of their supply from the atmosphere. The other bodies, such as the magnesia, oxide of iron, sulphuric acid, etc., exist always in sufficient quantity in the soil, and the air contains enough carbonic acid to nourish the plant.

M. Audoynaud, the learned professor of the School of Agriculture of Montpellier, has confined himself to the measurement of the potash, the phosphoric acid, and the lime in the ashes from the wood and leaves, and to the measurement of the two first bodies in those from the fruits. In reality, for researches simply made for agricultural purposes, these measurements are the most important, as they concern vegetable nutrition more directly; however, we must also consider that the measurement of the azote should not be neglected. On the other hand, M. Audoynaud has measured the *carbonic acid*, the results of which we have not deemed necessary to compare with ours, as the quantity of that acid varies more or less according to the process followed in the incineration of the plants. Furthermore, the measurement of this body explains very little, since it need not be restored to the soil, the air furnishing it in abundance.

The results obtained by M. Audoynaud differ sensibly from ours, and they cannot be compared, as he operates upon divers varieties of olives, cultivated and even wild, grown on calcareous or siliceous lands. From his studies may be gathered that the *lime* predominates in the leaves and wood, while there are but few traces of it in the fruits. It must be noted also that these olives, although coming from a calcareous land, do not contain a large quantity of lime, while our olive, cultivated in a silico-argilo-calcareous soil, has a pretty large quantity of lime.

Dr. Schaedler bestowed his attention to the analysis of the ashes from the olives (fruit), as also to the immediate analysis of the latter, the comparison of which will be made further on.

In regard to the results obtained for the elements of the olive ashes, we must say that they are near ours as to the *potash* and the *phosphoric acid*, but they differ sensibly as to the other bodies. In fact, he finds but half the *lime* we obtained from the fruits, while afterwards he meets with a quantity of *soda* much greater than ours.

From the above is inferred that the quantity of *lime* contained in olives is greater than is generally believed, while *magnesia* exists in them in small quantity, and it would seem that *it stops* in the leaves, where it is mostly found.

Potash, on the other hand, is much diffused in the olives, which it sensibly decreases in the wood and leaves, which are rich in *lime*.

The *phosphoric acid*, on the contrary, according to us, gradually diminishes from the wood to the fruits.

The young branches compared with the old contain less *lime*, though having a larger quantity of all the other bodies.

Silica is very plentiful in the fruits and scarce in the wood and leaves.

We present in the following table the comparison of the immediate analysis of the olives, made by the different authors:

Comparative Table of the Immediate Analysis of the Olives.

DETERMINATIONS MADE.	Parts of the Drupe.	Stanchowich.	Sieuve.	Ridolfi.
Rates per 100 of the parts which constitute the drupe	[a] Pulp		74.604	
	[b] Stone		21.356	
	Kernel		6.728	
Water	Whole drupe	51.25		51.00
	Pulp			
	Stone			
	Kernel			
Fatty substance	Pulp	[c] 9.39	26.676	10.00
	Stone	[d] ?	7.584	[e] 1.00
	Kernel	0.62	3.668	
Organic matter	Pulp	14.38		16.00
	Stone	20.00		22.00
	Kernel	0.16		
Ashes	Pulp			
	Stone			
	Kernel			

DETERMINATIONS MADE.	Parts of the Drupe.	Schaedler.	Mingioli.	Paparelli.
Rates per 100 of the parts which constitute the drupe	[a] Pulp	71.429	[g] 75.3407	80.500
	[b] Stone	23.225	18.9456	19.500
	Kernel	5.356	3.7041	
Water	Whole drupe	34.62	49.94	52.60
	Pulp	24.22	48.45	58.00
	Stone	4.20	19.69	23.00
	Kernel	6.20	29.40	27.00
Fatty substance	Pulp	[f] 56.40	[h] 30.4282	27.620
	Stone	5.75	1.2135	3.503
	Kernel	12.26	26.5790	21.600
Organic matter	Pulp	16.70	[i] 21.8770	12.680
	Stone	85.89	79.0247	72.967
	Kernel	12.26	42.0310	50.200
Ashes	Pulp	2.68		1.700
	Stone	4.16		0.530
	Kernel	2.16		1.200

---

[a] The sarcocarp and epicarp together.

[b] The wood of the pit (endocarp).

[c] Stanchowich, Sieuve, Ridolfi, Schaedler, like us, have operated upon the whole pulp (sarcocarp and epicarp together).

[d] The author doubts the existence of oil in the endocarp.

[e] We believe this rate comprises the oil of the endocarp and kernel together.

[f] The author does not say whether this rate refers to the dried substance or to the original matter.

[g] In comparing the results of M. Mingioli, we took the average of the figures which he gives in his study on the immediate analysis of olives.

[h] The author has measured separately the fatty substance in the epicarp and sarcocarp.

[i] These rates correspond to the organic and mineral matters together.

Although many determinations have been made in the immediate analysis of olives, we shall compare only those which concern chiefly the culture and fabrication of oil.

To this end we shall consider at first the weight of the different parts constituting the fruit as related to its total formation.

M. Sieuve was the first to make this determination; his results show a certain relation with those obtained by MM. Shaedler and Mingioli, and by ourselves. The variations found therein are due to other circumstances, as stated elsewhere.

While comparing the results obtained by the divers authors in the quantity of fatty substance, we find that M. Mingioli alone has measured it in the epicarp (skin) of the olive. As we only measured the fatty substance in the epicarp and sarcocarp (flesh) together, we could not make any appreciation of this measurement. It is with much pleasure, however, that we acknowledge this measurement as being very precious in scientific researches, with respect to the place of the fatty substances in the olive drupe.

As to the quantity of total fatty substance in the pulp, we find great differences; in fact it may be seen by the preceding table that MM. Ridolfi and Stanchowich, through mechanical means alone, and the weakest possible, have found a much smaller quantity of oil than is generally obtained in the factory.

M. Boussingault, in his book "*Economie rurale*," writes that olives yield from 9 to 11 per cent; but M. Albin Marcy, on the contrary, gets from them 25 per cent. M. Sieuve, although he has used only mechanical means for the extraction, has obtained 20.676 per cent, a quantity which, like M. Marcy's, is nearer the true value.

The quantity met with by M. Shaedler seems to us too large, and we therefore believe that he gave it with reference to the dry substance.

The rates obtained by M. Mingioli and by us are higher than those found by the others, because the extraction of the oily matter was made by solvents.

These results obtained through analysis prove us that in the oil industry, as it is actually carried on, there are losses of oil, which remains in great part in the oil cakes and can be extracted only by means of solvents.

The fatty substance contained in the endocarp has brought forth many contradictory discussions among authors. A few have denied its existence in the endocarp; others have said that there was very little, and others lastly have announced enormous quantities. These facts have been cleared up by our researches and those of MM. Schaedler and Mingioli.

M. Stanchowich doubts the existence of any oil in the endocarp; Rozier (abbé), Amoureux, Bernard, and Gandolfi deny it at first, then, after repeating their experiments, admit its existence. On the contrary, M. Sieuve, who first said he had found 50 per cent, believes he should deny it after other essays, but finally he again admits its existence in the proportion of 7.584 per cent. Mr. Pellegrini positively denies the existence of oil in the endocarp.

The oil of the kernel is met with in small quantity by Stanchowich, Sieuve, and Ridolfi; M. Schaedler makes it reach 12.26 per cent, but this rate is too low compared with that found by M. Mingioli (equal to 26.579 per cent) and ours (equal to 21.60 per cent). The variations met with in the immediate analysis of olives depend as much on the nature of the soil as on the variety of the olives themselves, the state of ripeness, the date of the harvest, the methods of measurement of the immediate principles, and many other causes.

This proves to us that the immediate principles contained in olives are susceptible of variability, but this is always confined within a certain limit.

We give below the comparative table of the immediate analysis of the oil cakes from olives:

Comparative Table of the Immediate Analysis of the Oil Cakes from Olives.

BODIES MEASURED.	Petermann.	Sestini (1).	Rossi (2).	Mingioli (3).	Paparelli.
Water	10.77	12.779	12.97	24.125	12.000
Fatty substance	25.69	13.837	13.61	17.425	11.457
Azotized matter	8.56	6.174	7.90		9.717
Non-azotized matter	22.36	60.999	31.91		27.678
Cellulose	28.64		28.82		37.047
Ashes	3.98	6.156	4.78		2.100

(1-2-3.) For Mr. Sestini, we have taken the average of two of his analyses; the same for Mr. Rossi. As to M. Mingioli, we compare only the average of the results which he has obtained with oil cakes coming out of the ordinary press, because we have operated upon oil cakes of same origin. The author has employed as solvents either sulphide of carbon, or ether, but as we have used the former, we have compared the results which he has obtained with that one.

In comparing the immediate analyses of the oil cakes, we shall refer especially to the rates of fatty substance. A glance over the preceding table informs us as to the great variability met with in the quantities of fatty substance found by the different chemists.

M. Petermann, with 25.69 per cent, presents the greatest quantity; then comes M. Mingioli, whose rate is also very high at 7.425 per cent.

The rates found by MM. Sestini and Rossi are nearest ours; but we still hold that these quantities are very variable, owing to the imperfect machines and erroneous methods yet employed to-day in the extraction of the oil.

In the meantime, it must be considered that however rationally the mechanical forces may be employed for the extraction of the oil from the oil cakes, there always will remain a certain quantity which can be drawn out only through chemical agents.

The quantity of azotized matter met with by us is larger than that of all the others. This measurement has a great importance with respect to the alimentation of live stock and manuring.

Following is the comparative table of the analysis of the ashes from the oil cakes:

Comparative Table of the Analysis of the Ashes from Olive Oil Cakes.

BODIES MEASURED.	Petermann.	Sestini.	Rossi.	Paparelli.
Potash	28.25	6.585	11.93	28.942
Soda	6.89	8.557	8.98	5.279
Phosphoric acid	8.80	5.824	4.91	9.447
Lime	21.83	3.114	6.95	22.953
Magnesia	1.07	2.638	2.44	1.121
Oxide of iron and alumina	7.82	23.702	19.67	4.406
Sulphuric acid	4.15	4.628		1.594
Silicic acid	20.35	6.016	40.00	26.190
Chlorine	0.83	0.314		0.068

From this table may be seen clearly that the analysis which agrees the most with ours is that of M. Petermann. The variations between these two analyses and those of MM. Rossi and Sestini are too great; such small quantities of potash and lime cannot be admitted, nor those too large of oxide of iron and alumina. In fact, the analysis of the ashes of olives enlightens us on this point.

Other analyses in this connection may establish within what limits these figures may vary; for the moment it may be said that the quantities of potash and of phosphoric acid in the oil cakes equal those of manure, and they are therefore very available for the manuring of the olive itself.

VII.

CLIMATE AND ABODE OF THE OLIVE.

According to De Noisette, the olive does not grow beyond the terrestrial zone comprised between the 25th degree and 43d degree (no further than the 45th degree) of north latitude, and between the 15th degree and 33d degree of west longitude, according to Tavanti; zone which Bonalumi, quoted by Cappi, thus poetically describes:

"The olive with its velvety zone of pale green, stamps upon the surface of the globe the sweetest of all the *Cistemeriche* (Cistineae)—the line of the fifteen Celsia which passes through so much poetical scenery by land and by sea. That line which detaches itself from the southern isles of Japan, grazes the headlands of Corea, cuts by the middle the Celestial Empire, Kinghisia Turkistan, and the Caspian Sea, ascends and greets the prophetic summits of Lebanon, glides down the valleys of Anatolis by way of Smyrna, crosses the Grecian Archipelago, enters the most delightful Arcadia, traverses the Adriatic and the flowery hills of the Aino, skirts the incomparable coast of Liguria, and dies away at the foot of the Pyrenees."

From the west of Europe and Portugal it is lost in the ocean.

The special conditions of place and exposure favorable to the olive, and which exist in the above zone, are the hills slightly inclined towards the sea, those with a good exposure, places bathed by the placid waves of lakes, which are a continual source of gentle heat during winter, or again, the mountain summits, where it is protected from the severe northern winds.

The olive, says Agostino Gallo, does not fruit unless set out in a warm location on a mountain or hill, or at their foot, and always on the eastern or southern slope. Excessive heat and intense cold are contrary to its welfare. Indeed, it is not found in Africa beyond Mount Atlas, and Humboldt observed in various parts of South America, as did Poiteaux at San Domingo and Cayenne, that where the olive can grow in those countries they never come into bearing.

To summarize, the *Oleo europaea* (European olive) is found:

In *Oceania:* Southern Australia, and Island of Java, near Batavia.

In the *Americas:* Chili, Peru, plateau of Mexico, Guadalupe, Hayti, Cayenne, Florida, Louisiana, Texas, but more extensively in California.

In *Asia:* Asia Minor, Mount Giacourdagh, in northern Syria, Mount Sindjar, in Mesopotamia (now Kurdistan), Valley of Sefirud, in northern Persia, Mount Akadar, in the Province of Maskat, at the southeast of the Arabic Peninsula.

In *Africa:* Egypt, Tripoli, Tunis, Algeria, Morocco, Canary Isles, regions below the Anstral Mountains, of Nubia, as far as the Red Sea, and a few places on the Island of Reunion.

In *Europe:* Nearly all the Mediterranean coasts and Portugal.

Some people believe that the olive should be raised near the sea. Experience, however, has demonstrated that this is not the case, since the olive grows and fructifies perfectly well in the interior of continents and at the greatest distance inland. It is mostly found in the vicinity of the sea, because there it meets a temperature more uniform and favorable to its welfare. It grows and bears, as a rule, in higher localities than the vine, but lower than the chestnut tree, and does best in the region of the fig and the almond tree.

The olive begins to grow when the temperature reaches about 53.6 degrees Fahrenheit, and blossoms at 64.4 degrees, or 66.2 degrees Fahrenheit. A temperature of 23 degrees Fahrenheit, followed by a quick thaw caused by the sun, is enough to make it perish entirely. With a lower temperature, but not followed by a sunny day, it does not suffer as much, being able to withstand a cold of about 14 degrees Fahrenheit. It is not much hurt either by a low temperature followed by sunny weather, if its exposure be such as not to receive directly the rays of the sun at morning.

It is not so much the frost that injures the olive, as the sudden transition from cold to heat and the quick return of frosty weather, which are its greatest enemies, as, for instance, when the snow covering its branches melts partly under the influence of the sun, to be congealed again at the approach of night. At 11.6 degrees Fahrenheit, not only the leaves perish, but also the stem and the roots that are close to the surface.

A frost of equal intensity is more fatal to the olive in the spring than in the winter, because in the spring the plants have entered into the period of vegetation, and their tender buds are liable to be destroyed. Cold weather, with an atmosphere loaded with vapors, is more harmful than with a dry atmosphere; and this is why, with the same degree of cold, the olives of the lowlands (because surrounded by an atmosphere full of vapors) undergo more damage than those situated on the hills. It has been noticed that frost injures the weak and debilitated olive plants sooner than the robust, other things being equal. The herbaceous vegetation is first disorganized, then the branchlets, the branches next, and last of all the trunk.

The greatest peril, then, lies in the intensity of the frosts, the persistent humidity of the atmosphere, and the rapidity of the thaw. Indeed, after the rapid thaw of 1709, two days of sharp frost, with a temperature of 8.6 degrees Fahrenheit, were sufficient to kill nearly all the olives from Perpignan to Nice, and to damage a great number between Nice and Genoa, and between Genoa, Pietrasanta, and Piombino. In the winter of 1846–47, the thermometer registered 8.6 degrees Fahrenheit in the neighborhood of Florence, and as low as 4 degrees Fahrenheit for about a quarter of an hour in 1849. It recorded only 12.2 degrees Fahrenheit on the ninth of December, 1871, at Florence, in the upper Val d'Arno, in the valleys of the Elsa, in Chianti, in the valleys of the *pistojan* Ombrone, and elsewhere, and from 19.4 degrees to 14 degrees Fahrenheit on the Pisan hills.

There was a great loss of olives on these occasions, but a great number which thawed gradually under the action of the rain or in cloudy weather, were not badly damaged, except in the higher branches, and a few in the lower part of the tree. In the winter of 1879–80, a great quantity of plants were again almost wholly destroyed or killed by frost in the same localities. All the damage, however, was not caused by the thaw; in the latter instance, it was also brought about by the aridity of the soil, which had been very dry for a long time, as was shown by the scarcity of water in the rivers, which kept frozen for several days. The plants were burnt, deprived of moisture internally and suffocated externally by the extremely low temperature. During the month of December, 1883, on the other hand, there was, instead of a thaw, an unexpected frost following a very mild and humid temperature, which damaged the tops and fruit of the adult plants, and killed a large quantity of young ones, because we had had for a long time warm weather and copious rains, and the plants were caught in full vegetation.

To offset its extreme sensitiveness, the olive possesses great vital power in its roots, which always live, though the tree be dead; and this is the reason why the olive is never lost, as even after the trunk has been cut off, the roots throw up new shoots, from one of which may be obtained the young plant. It is to be recommended, nevertheless, not to plant the tree in regions exposed to extremes of cold or heat, as it suffers equally from both.

It seems certain that the olive can withstand without grave injury a temperature of 19.4 degrees or 17.6 degrees Fahrenheit, provided it lasts not longer than a few days; at the same time it can live and fruit, without harm, in a temperature of 104 degrees and 107 degrees Fahrenheit, in the height of summer. Caruso very properly says that meteorology applied to agriculture is yet in its infancy; we know nothing positive about the true temperature required by plants, both as regards the air in which the stems and leaves live, and the ground into which they extend their roots. The researches made in that direction are quite recent and limited to a few countries, nor do they relate to all the plants in the dominion of rural economy. They do not, therefore, throw enough light upon the subject to enable us, at present, to draw up sure rules.

This branch of scientific researches is steadily progressing, and views as a praiseworthy example those recently made in the garden of R. Tuscan Society of Horticulture of Florence by Prof. Ferdinando Meucci.

I reproduce here nearly the whole of an article on "The variations of cold during the night," published in the *Bulletino* of the R. Tuscan Society of Horticulture of August, 1876:

"There is no doubt but the study of the nightly cold is of the utmost importance in meteorology applied to agriculture and horticulture. The intensity of cold diminishes by degrees as one rises to a certain height; hence it is that in clear nights the increase of the temperature is in proportion to the altitude. Pictet, in 1778, Six, in 1784, Marcet, in 1837, Bravais and Lottin, in Lapland, in the winter of 1838–39, and Plantamour, at Geneva, in 1847, all bestowed their attention upon the study of this phenomenon. At the end of 1860, Professor Martins began a series of observations on this subject, at Montpellier, placing several thermometers at various heights, from the lowest part of the botanical garden up to the top of the belfry of the cathedral of that city; that is to say, from two inches to one hundred and sixty-two feet above the ground. There were marked differences in temperature on clear nights, while he could hardly distinguish any when the sky was cloudy. In fact, he found out, by taking the average of all the clear nights for a whole year, that the mean increase of temperature had been 9.46 degrees Fahrenheit for a height of one hundred and sixty-four feet, while for the cloudy nights it had not exceeded 1.92 degrees Fahrenheit. Leaving aside the yearly average, and taking up the study of the phenomenon for the months of December, January, and February, during which the cold is more intense, we shall find the confirmation of the same law. During one winter at Montpellier, where the temperature was 32 degrees Fahrenheit, a difference in height of one hundred and sixty-four feet showed a change of 8.46 degrees Fahrenheit on clear nights, and only 2.64 degrees Fahrenheit on cloudy nights. But the increase of temperature is not at all uniform, it being greater near the ground than higher up; indeed, it was observed (always on clear winter nights) that the difference was of 2.37 degrees Fahrenheit between two inches and six and one half feet, nearly, from the ground, of 0.57 degrees Fahrenheit between thirteen and twelve hundredths and nineteen and sixty-eight hundredths feet, of 3.71 degrees Fahrenheit between nineteen and sixty-eight hundredths and eighty-three and thirty hundredths feet, and, lastly, of only 1.89 degrees Fahrenheit between eighty-five and thirty hundredths and one hundred and sixty-four feet. Summing up all the clear and cloudy nights for the winter, Professor Martins ascertained that the increase in the nightly temperature at Montpellier was 7 degrees Fahrenheit per sixteen feet five inches, or about 0.072 degrees Fahrenheit per three feet three and one third inches, at the greatest elevation, while in the first nineteen feet eight and one third inches from the ground there was an increase of 3.43 degrees Fahrenheit, that is to say, 0.61 degrees Fahrenheit for every three feet three and one third inches. The conclusions to be drawn from these facts, to the advantage of agriculture and horticulture, are worthy of much consideration. These facts explain to us why, in colder winters, the more delicate trees and shrubs are injured in their lower branches, which are near to the ground, and why it is colder at the foot of a hill than up its sides or at its summit. Professor Martins recalls, in this connection, the two disastrous winters of 1855 and 1870. At Montpellier, in 1855, there were fifty-three days of frost, the month of March included, and the thermometer fell down to 0.4 degrees Fahrenheit at the lowest part of the botanical garden. In 1870 there were sixty-seven frosty days, and the thermometer fell down to 3.38 degrees Fahrenheit. During these two winters all the olives in the plain between Nimes and Montpellier perished, down to the roots, while those situated in higher locations remained unhurt. The same happened to the laurels, which are set out on a hillside in the botanical garden; those planted high up were saved, those planted lower down perished. The vines even were caught by the frost in the lower parts of the plain, but did not suffer at all on the hills. We also, unfortunately, have witnessed analogous occurrences during the memorable winter of 1872, when such a large number of vines were destroyed in Tuscany, not to speak of the olives nor of so many other plants cultivated for profit or pleasure. Let us, finally, call the attention of our readers to the remark which Professor Martins deems useful to make at the end of his letter:

"'A few agriculturists and horticulturists,' says he, 'attribute exclusively to the humidity of the air the damages suffered by the various plants in the lower and more depressed places, but this humidity, manifested by fogs or mists close to the earth, is precisely the result of the decrease in temperature at a short distance from the ground. Its influence will certainly be added to the action of the cold, and may render it still more deadly; but it cannot be said, however, that humidity is the efficient cause of the damages which horticulture laments.'"*

The altitude in which the olive tree can live differs according to the different regions where it is cultivated. Generally in the central regions of Italy seldom it goes beyond one thousand six hundred and forty feet above the sea level, in the basin of the Iseo and Garda Lakes the extreme limit being at one thousand four hundred and seventy-eight feet, and in Sicily reaching as far as two thousand three hundred feet, but Professor Aloi says that in the center of Sicily he has found olive trees in full vegetation at an altitude of two thousand six hundred feet above the sea level.

---

* From a letter by Professor Ch. Martins, in the *Journal d'Agriculture pratique*, of Paris.

In the maritime region of Sicily, in the extreme southern part of Sardinia, in Calabria, and in Salento (terra d'Otranto), often the olive trees suffer by dryness and aridity. On the contrary, they thrive well in the middle zone, called in Sicily mezzalina (composed of hills, high flats, and hill slopes), above three hundred to two thousand five hundred feet of altitude. Higher up in the mountainous zone, they thrive less, because of the cold, and reach a lower height. Above three thousand two hundred feet, the cultivation ceases on the southeast side of the Mongibello; after two thousand seven hundred and thirteen feet, in the garden of the ex-convent of S. Maria del Bosco, of Caletamauro (province of Salerno); above two thousand five hundred feet, at S. Mauro Castelverde, beyond the Madonic (Province of Palermo).

In Terra di Bari, Capitanata, in the Abruzzi, in the rest of Sardinia, and in the lower part of Corsica, in Campania, in the Principati, in Molise, and Benevantano, in Basilicata, and southern Lazio, the olive tree can be cultivated as far as one thousand six hundred and forty to one thousand eight hundred feet of altitude; at one thousand four hundred and twenty feet it can be seen at Solofra (Principato Ulteriore) on a hill exposed to the south. Above these limits its life is not thrifty and its production is casual. Near Solofra, on the hill of Turci (well sunned and sheltered), the olive tree may be seen at about one thousand nine hundred and sixty feet of altitude, but it has a sickly appearance.

In Liguria, Tuscany, Marche, in the rest of Lazio, Umbria, in the Illyric Peninsula, and about the Lakes Maggiore, Garda, Iseo, and Como, the limits in altitude for the cultivation of the olive tree stop according to the localities at from six hundred feet to one thousand six hundred feet. In some of these places the olive tree may vegetate at greater heights—at one thousand six hundred and fifty, and even one thousand nine hundred feet; but there it does not thrive and produce enough to exclude the cultivation of other plants. For instance, on the hills well exposed of Pesaro, Iesi, Amona, and Valpolicella (Verona), there can be seen a few olive trees mixed with other cultivations, on which the agriculture chiefly depends.

From the foregoing, it appears that all Italy (the great valley of the Po and the elevated portions of the mountains excepted) is included in the geographical and altitudinal limits of the olive tree. From Nice to Genoa and Pisa, from Naples to Paola and Reggio of Calabria, it occupies all the slopes of the Apennines to an altitude that, from nine hundred feet in the localities less temperate, reaches two thousand nine hundred feet in the warmer regions. On the opposite Adriatic and Ionio slopes, the tree of Pallas can only be seen near Rimini, San Marino, Montescudo, Verrucchio, and San Leo. From these points, still keeping at an altitude but little lower of the coast of the Tyrrhenum, it goes without serious interruptions to Ancona, Fermo, Terano, Pescara, Vasto, Bartella, Bari, Lecce, Otranto, Taranto, Cotrone, and Reggio Calabria. In Sicily the olive tree rises from the sea as far as up to three thousand two hundred and twenty-eight feet; from two thousand five hundred and seventy-two feet in Sardinia; from two thousand two hundred feet in Corsica.

VIII.

VEGETATION AND LIFE OF THE OLIVE TREE.

The olive tree left to itself in uncultivated lands, grows very slowly, rises but little from the ground, assumes the appearance of a shrub rather than that of a tree, puts forth few leaves, seldom bears fruit, and its berries, having very little pulp, make an oil of inferior quality. On the contrary, when the plant is cultivated according to the soil and the climate where it is developing, not only at times becomes a tree of fine appearance, but also majestic, and with a top of extraordinary circumference. When becoming old, its trunk putrifies in many parts, and by these ravages, in the progression of years, it becomes empty, and yet a few thin wooden fibers adhering to the bark suffice not only to give it a lease of life for many years to come, but to make it yield fruit regularly.

At its feet, where the trunk is united to the roots, it develops in the large roots certain ovoidal swellings, provided with germs, from which suckers or shoots come forth when the tree is in full vegetation. In summer time any one may have noticed in the grown up trees these swellings, which are commonly known by the name of eyes or ovules, which perform the part of the seed in the reproduction of the plant. When the latter has been destroyed by the frost or by age, it is evident that these ovules or eyes put forth the shoots, and the stronger ones become new trunks.

It is observed by Tavani that the neck of the olive tree is often of such dimension that it may be attributed only to a disease. It is known that these monstrosities do not exist in the olive groves cultivated in Chili, nor in those of Palestine; in the latter country, because it is there indigenous; in the first one, because it finds there the conditions favorable to its vegetation and a new home. Besides a portion of this neck is often due to the injuries to which the olive tree is exposed, because of the depression of the adjacent ground; consequently these necks are more extended in that direction to the trees cultivated on the hills than to those of the plains.

The roots of the olive tree issue from the neck and descend in the ground under various inclinations and with different ramifications. In some cases they consist in a mother root, normal to the soil or, as they say, a main root, which originates many very thin and capillary rootlets; in other trees there can be seen only radicles more or less horizontal, all issuing from the neck, subdivided into smaller ones and these into others, and so on to the smallest. Seldom roots of this double species may be seen connected together; we will see hereafter for what reasons these different circumstances are happening.

The dimensions of the roots depend from the strength of the tree and from the facility of penetration offered by the soil. There have been seen superficial roots having a length of thirteen feet by three inches and more of diameter. Their ligneous substance is whitish with a tendency to yellow, and in regard, especially of the mother roots, to the merit of hardness, durability, and uniformity, they add that of being unalterable to the action of the insects. It was perhaps for this reason that the Greek sculptors preferred it to represent the images of the gods.

The trunk of the olive tree has its basis on the neck, and its apex at the origin of the branches. Its elevation, its diameter, the number and the disposition of these branches are all accidental circumstances depending from the conditions of the exposition of the tree and the mode of its cultivation.

In its first development the olive tree has a smooth bark, ash-colored outside, light-green inside; its liber (the part lying next to the stem), is white and tender, the fiber compact, the medullar substance* granulated and dense.

The grown up olive tree has the epidermis brown, unequal, marked with cracks; the wood is reddish, resinous, brittle, knotty, oily, speckled, and combustible with equal facility both when green and dry.† The diseases, the injuries from animals or from the seasons, a neglected cultivation, etc., alter its conic truncated form, and often reduce it to such extreme irregularity as to hasten its decline and death.

Frequently the branches issue from the tree at the pleasure of the cultivator, by whom they are excited and disposed, and by whom they are removed by pruning; from these prunings grow, two by two, opposite shoots, alternately laid crosswise. The olive tree in its natural state assumes a regular ramification.

The bark adheres more to the wood in summer than in winter; in the latter season it can be easily separated, when it is deadened by the frost or by a stroke of the sun; hence, the snow, the white frost, remain on it longer, and hence the more serious damages of a hasty or careless gathering of olives.

The evergreen leaves of the olive tree are renovated like in the other plants, alternatively from two to three years; the new hasten the fall of the others, which before falling grow yellow, and appear on the branch two by two, one against the other, the two superior crossing the two lower ones; and in this manner issue also from their axils the new small boughs. The ancient writers have noticed the twisting up of the leaves, by which the color of the mass of the branches is changed from silvery gray to green gray; they hold that at the end of the summer it was a sign that the solstice was terminated. That phenomenon is not peculiar to the olive tree, but common to other plants, as it is noted by Vettori, and it is caused by the extreme heat of those days, which dries in such a manner their ribs and leaves that they turn upside down. We have also noticed, both in summer and in the other seasons, that an identical effect is produced by a violent and long wind blowing when the soil is rather dry.

The leaves of first development appear of a lighter green than the others. A little before the beginning of April there appear in the axils of the first leaves greenish excrescences of panicles, sustained by a common peduncle; in proportion as the system gains in consistence and growth, these round panicles take a pyriform shape, where can be seen already appendages or stipules turned down; this is the bud of the blossom disclosing in June.

The disposition of these bunches, uniform perhaps in the native land of the olive tree, is not identical in our own country; on the contrary, there are irregularities in regard to the number, the conformation, the age, etc., of the buds themselves.

The gems of the first leaves have not the envelopes with which nature protects them from the injuries of the storms and of the frost as other plants of the glacial, as well as of many of the temperate zones; a very interesting character that shows the difference between the olive tree of other countries and that of our own climate.

The flower, or blossom, develops on the branches of the preceding year and also of two years, immediately after the awakening of the spring vegetation; nay, the more early the experts notice on the trees the apparition of the blossom, the more abundant they expect the crop to be. The olives produced from the flowers first expanded are the most certain to reach maturity, the second less, and those of the last are generally lost.

An abundant crop is indicated by the trees themselves, that is, when they are vigorous and are covered with blossoms from the top down, because on the extremities of the higher branches the flower-buds are generally scarce, while there flourishes the development of the wood; consequently if the high flower-buds are also abundant, it is logical that all the plant be full of them. Nevertheless, the hope of a good crop may disappear, when the arid soil, under an ardent sun, or the continued rainy and the cold wind conjure, during the blossoming time, against the success of the fecundation.

When the olive tree finds favorable conditions of climate and soil, it is one of the most vigorous plants, and can even compete with the oak. Pliny says that there were at Luiterno, in the Roman Campania, some olive trees planted by Scipio, the African, two hundred and fifty years before. Extraordinary for age and height are the Saracen olive trees of Sicily, some of which, says Pasquale, have produced as high as fifty bushels of olives.*

The trunk of one of those trees, near Girgenti, measured twenty-six feet four inches in circumference at five feet nine inches from the ground. In the province of Cosenza there are still some very old trees which are said to belong to the times of Louis d'Angio, Governor of Calabria. Some of them have trunks of extraordinary size, empty inside, in which many persons can stand. Thiebaut de Bernaud describes an olive tree situated between Villafrance and Nice, which was already known in 1815 to be exceedingly old, whose trunk, at three feet from the ground, measures twenty feet six inches in circumference. One near Marseilles is mentioned by Ceyreste, which is thought to be nine hundred to one thousand years old, and so gigantic that it can harbor in its interior twenty persons; and another at Tarascon, on the top of a hill, with branches seventy feet long. It is asserted by Gasparina that he has seen, near Rogliano, in Corsica, olive trees fifty feet in height. Very beautiful and fruitful wild olive trees are admired at Mount Amiata.

Repetti, writing of Magliano, Tuscan Maremma, mentions the gigantic olive trees spoken of by the naturalist Giorgio Sauti, in volume two of his "A trip in the Province of Siena." The stem of this tree measured thirty feet in circumference. It is yet standing.

In 1853, at the Fair of Paris, there was exposed the trunk of a wild olive tree of Algeria, thought to be one thousand years old.

On Tianosa Island (Tuscan archipelago) there are olive trees of such immense size that they must have been in existence before the cession of the island, that is before 1600.

It is related by Targioni that on the hills of Fiesole there was an olive tree as large as an oak, and known under the name of Michael Angelo; in fact, that property belonged to the Buonarotti family, and, according to the tradition, that tree was planted by Buonarotti himself. The same writer speaks of another olive tree, on the hills of Bagno a Ripoli, off Candeli, supposed to have been planted by St. Antoninus, Archbishop of Florence, who died in the year 1445.

Tgnazio Lavaggi advised in one of his letters to visit the celebrated groves of olive trees near Tivoli, one of which, and very likely it is there still, could not be embraced by three persons, and had branded on its trunk the design of a sword, which seemed very old.

---

*The pith is so thin that Theophrastus compared, in this, the olive tree to the box tree; some writers even attest that it has no pith.

†This peculiarity has often occasioned the burning of large olive plantations.

*Professor Aloi, however, corrects this: "I have ascertained that the higher production of the largest olive trees of Sicily never exceeds two hundred and sixty-four gallons of olives, and even this quantity is reached very seldom." Consequently, the remark of Pasquale seems to be exaggerated.

Professor Caruso writes: "The most remarkable olive trees I have seen are situated at some maritime places of Sicily (plain of Palermo and Milazzo), in the forest of Pertinicio, on the coast of the Ætna, in the plains of Syracuse, in Calabria (plain of Palme), and in Puglia (Terra d'Otranto). Their majestic appearance is justly attributed to the general practice of the ancient cultivators of those regions of multiplying the olive trees with the wild species gathered in the woods, and grafting them very high from the ground. The enormous height is the effect of the olden order of pruning the trees very little or not at all, so that they grew thick and confusedly, as in a thick wood, forcing the branches to stretch up continually in search of air and light. This is the reason why the old groves of the plain of Calabria, at about one mile from Palme, have the appearance of long poles, dressed on top with a scarce foliage and a quantity of dried leaves, which make a striking contrast with the vigor of the trees, the mildness of the climate, and the fertility of the soil."

As Bianchedi writes: "We are not permitted to-day to see the celebrated forests of olive trees, under which rode, in 1482, Marin Sannto, nor can we see the town of Salo, at Gargano, full of olive trees, which, as it is related by Roga, were extolled, in 1558, by Leandro Alberti. Of that large and luxuriant surface there remain no trace to day; the last one* was admired by many some twenty years ago, on Lechio Island or Frati Island." * * *

IX.

TEMPERATURE.†

"Trees, like all other bodies, absorb a certain degree of heat, which serves to maintain their vigor and modifies the surrounding temperature. Part of the heat of a tree is derived directly from the solar rays and indirectly from the ground warmed by the same. The small branches absorb the solar heat to a rather great extent, and that is why their temperature may be higher than that of the surrounding air. Mauquenne found that the upper face of the leaves absorbs more heat than the under.

"The large leaves also very often absorb the heat better than the small ones. Trees lose at night the heat gathered during the day. In woods, however, the tree tops constitute an obstacle to this radiation; hence the night temperature is somewhat higher in the interior of woods.

"To the purely physical phenomena presented by the air and the ground, as to their temperature, are added, in vegetables, physiological phenomena apt to modify the results obtained.

"In the same manner that life develops in animals a heat of its own, thus there is produced in vegetables a certain amount of heat, although much smaller. In animals the greatest heat is developed by the organs which perform their functions rapidly and continually. So in vegetables, the heat is more perceptible in the young and vigorous parts, and where the absorption of oxygen and emission of carbonic anhydride are greater, as in flowers and germinated seed.

---

* Said to have been planted by St. Francis at the beginning of the thirteenth century.
† Canevari: *Agricoltura Italiana*, fasc., February, 1883.

"Plants give organic products in which is found part of the vital force given them by the sun in the form of light and heat, and put this force at the disposition of animals which seek it under the form of food; for the same reason, part of it is consumed by the vegetables themselves, especially when performing some of the acts relating to the conservation of the species. Seeds in germination, flowers, principally at the time of fecundation, fruits during maturation, absorb oxygen and develop carbonic anhydride in rather large quantities; then they develop heat. In the wood and leaves these same effects are produced with greater slowness, and during the day they are hindered by the inverse effect which accompanies the work of assimilation, as also by the important quantity of heat necessary for the transpiration.

"De Lamark and De Candolle were among the first to point out the development of heat at the time of emission of pollen in the arum (wake-robin). Van Brek, Murray, Bergama, Saussure, and Mulder have found that the same phenomenon takes place in many other plants, although in a lesser degree. Thus, according to Saussure, there is only an increase of .9 of a degree Fahrenheit in the flower of the *Bignonia radicans* (trumpet-flower), .9 of a degree Fahrenheit, also in that of the pumpkin, and 2.70 degrees Fahrenheit, in that of the *Polyanthes tuberosa* (tuberose); in that of the *Cactus grandiflorus*, the increase is only a fraction of a degree. A strong development of heat is produced, on the contrary, during the flowering of the *Aroideae*, *Arum maculatum italicum* (common wake-robin or cuckoo pint), *Dracunculus* (dragon), *Colocasia odorata*, *Calla aethiopica* (lily of the Nile), *Caladium viviparum pinnatum*, in which, according to the observations of Saussure, Brogmart, Vrolik, De Vriese, Van Beek and Bergma, Goppert, Freviranus, Gartner, there is an augmentation varying from 10 degrees to 20 degrees (18 degrees to 36 degrees Fahrenheit). The indicated effects are more noticeable in the male organs than in the female.

"Generally outside the fecundation (the vital act *par excellence*) the heat developed by vegetables is so feeble, and is produced so slowly as to influence only in a manner nearly imperceptible their temperature, which depends then almost entirely on that of the air and of the ground. The temperature of the soil determines the temperature of the roots, which in turn influences that of the trunk by means of the ascending sap. The temperature of the aerial parts of vegetables is determined by the radiation and the evaporation of the leaves.

"Among the first experiments made with precision on the temperature of trees, may be reckoned those of Pictet and Maurice, performed on the chestnut tree from 1796 to 1800. Rameaux afterwards obtained diverse results.

"To the first thermo-electrical observations made upon the temperature of vegetables, belong those of Dutrochet. He found that plants and all their vegetative organs, as the leaves, young branches, and roots, have on an average an ambient temperature (Knop).

"The conclusions to be drawn from the best observations made, are the following: The heat is nearly null in the trunk of trees; this heat is derived first from the air, then from the ground. As the trunk of trees is a poor conductor of heat, the fluctuations of the external temperature penetrate it slowly as the interior of the earth, being kept back and remarkably weakened. In proportion as the sap ascends, its temperature tends to equilibrate itself with that of the air. In fact, Rameaux found that at the break of day and a little while after, the central temperature of the trunk decreases from the foot of the tree to its summit; the contrary takes place during the remainder of the day. In the first case, the soil is warmer than the air; in the second, it is colder. Rameaux subsequently poisoned some of the trees he was operating upon, and took off some of their branches; immediately the fluctuations in their temperature were considerably increased; the regularizing action of the sap was then disturbed.

"The above results were verified by very numerous and accurate experiments on the part of Becquerel, who availed himself, for that purpose, of his electric thermometer. He demonstrated also that, under certain circumstances, the variations in temperature might be considerable in trees of small dimensions, isolated and well exposed to the sun; this was one of his first determinations. Becquerel ascertained besides, that with a covering of straw of about one and one quarter to one and one half inches in thickness, the extent of the variations was reduced to about one third.

"The temperature of the leaves would follow still closer the thermometric variations of the air and the ground, were not these organs possessed of a remarkable power of absorption and radiation. The experiences of Becquerel demonstrate that the temperature of the air which surrounds the foliage of a chestnut tree, is higher, in the evening, than that of the air taken at a certain distance from the tree. The leaves absorb abundantly the rays of the sun, and become warmer than the air to which they transmit their excess of heat. After a warm day, the foliage of trees cools slowly, and when the nocturnal radiation has drawn out of the leaves their excess of heat, they still preserve from cold the bodies they shelter.

"This is verified in fields and prairies which are not very humid; there, during the day, the temperature is more elevated at the level of plants than at a few meters of altitude, but it is less than on a soil of identical nature, nude and dry.

"The opposite takes place during the night. Vegetables have a radiating power, just as great as their power of absorption. Welts, at the beginning of the present century, found that, in a meadow, during night, under a clear sky and in calm weather, thermometers, laid on the grass, registered a lower temperature than others at a height of three to six feet, and that the difference could reach 12.6 degrees, or 14.4 degrees Fahrenheit.

"The stratum of air next to the grass followed, though somewhat slowly, the variations of the temperature, but the difference still could be of 3.6 degrees, and 7.2 degrees Fahrenheit. The temperatures indicated varied much according to the state of the sky and the degree of agitation of the air.

"During winter, when the circulation of the sap is suspended, the effects produced by frost on the living trees do not differ much from those produced on the dead. The temperature of the ground, then, no longer influences that of the trunk by means of the sap; then the variations of temperature, to which it is subjected, become much stronger. They are much less than in the air, however, owing to the poor conductivity of wood for heat; hence, a sudden and temporary frost is not felt deeply in the trunk of a tree. The heat developed by congealing water, added to the poor conductibility of wood, protects it still further from the variations of temperature. All this, however, produces only a little delay, and if the frost be sufficiently prolongated the tree freezes; from that time it follows more rapidly the cooling action of the air. It resulted, from the experiments performed by Neffer and Halder, at Tubingen, in 1828, that often the frost penetrates into trees through a higher stratum than that offered by the water congealed upon them. The thickness of the trunks, the duration of the frost, the quality of the plants, modify also the results pretty much. Bravais, at Rossekop, and Thomas, at Kaafiord, made similar experiments, during the winter of 1839–40, on pines having a diameter of about six and one fourth inches. The temperature in the interior of the trunk followed the variations of the atmosphere with a delay of eight to twelve hours. With bigger trees the delay would have been greater. The minimum of heat observed in a tree was about one degree (1.0° Fahrenheit) more than in the air. Thomas found, by experimenting on two trunks, one of which was dead and the other living, that there were but very small differences in the way they each were affected by the temperature, when in winter the sap had no appreciable movement.

"The chemical changes undergone by the contents of the cells through frost have been but little studied so far. Einhoff has made a few observations on the saccharine matter of potatoes subjected to a low temperature. It seems to result, from the observations of botanists, that the death of single organs and of whole plants through frost depends upon the decomposition, and also, most probably, upon the destruction of the molecular state of the substances constituting the main parts of vegetative cells."

X.

PROPAGATION.

The reproduction of vegetables is easier than that of animals, and if to the latter one method of reproduction only is allowed, the first may diffuse their existence by various processes.* A portion of the bark about which frequent incisions have collected and condensed vegetable humor in a shapeless protuberance or ovulum, a branch torn off a robust plant, the trunk of a root not yet sterilized through inactivity and rest, etc., put forth, when properly cultivated, young sprouts that are now ready to replace the lost plants or originate new plantations.

Tavanti writes: "Yet the difference in the modes of indirect reproduction is only apparent. Any ovulum formed on the trunk, on the branches, on the roots, etc., becomes for the plant a new organ that contains, as in embryo, the system itself from which it issues; and its subsequent development depends upon the circumstances which exercise an active influence over it. Hidden from light, in an ambient soil properly moist and temperate, it produces roots, promptly followed by a shoot. Surrounded by the atmosphere and impelled by the repeated action of electricity and light, it is embellished with small branches, with leaves, and successively with tender roots. The experiments of Hales, Deuhamel, and Bonnet bear witness to this wonderful phenomenon.

The assertion of Amoreux, that the seed of the olive is not always prolific, is without foundation; though it may happen that, like the seed of other plants, it does not sprout owing to some anomaly or mishap of the season. All the efforts of the vigilant cultivator would be useless, if the seed were sterile. Among other facts that I could quote, I may mention what happened recently to the careful Tedaldo Marzichi, who found a large portion of one of his fields converted into a real nursery of small olive plants, because some of his trees had been stripped of their ripe fruit, two years before, by such a violent storm, that the olives were actually buried into the ground, and then, by the natural process common to prolific seeds, they had put forth young plants. It is a fact, however, that the olive, being a tree of foreign origin, does not always complete the maturation of its fruits. For this reason, certain persons, without searching into the true cause, believe that the seed enveloped in the drupe is barren or backward, and say that the olive by itself does not germinate spontaneously.

---

* In procreating plants, nature varies.

Professor Aloi writes: "The olive can be propagated—

"By seed,

"By ovule,

"By simple or ramified slips,

"By sprouts,

"By the old trunk,

"By small wild olive trees.

"All the small plants obtained by any of the above means require to be grafted, as they come forth in the wild state, except the plants coming from slips taken from above the grafting, or from plants that do not require grafting, and those that are obtained from ovula, from shoots, and from the old trunk of trees that do not require to be grafted.

DIRECT PROPAGATION, OR BY SEED.

"Although the plants that are propagated by seed require more time to grow and fructify, yet this mode of propagation is worthy of the attention of the horticulturist, because the plants coming from seed have a longer life, attain a larger size, and resist better to the frost, to the insects, and to diseases.

"The seed of the olive would germinate two years after sowing, putting it into the ground as it is; but Gasquet found out that, by macerating it for two or three days in an alkaline lye, it becomes able to germinate in the same year in which it is sown. The same effect is obtained, without maceration, by taking off from the seed the outer shell and softening the kernel in a batter of argillous earth and cow dung; thus treated and put into the ground, the seed germinates in the same year. This method has been suggested by Baron De Gasparin since 1822.

"To effect the propagation by seed, it is necessary to prepare at first a seedbed, ready to receive the seeds and capable to lodge the plantlets that come forth for two or three years, when they will have attained a sufficient size to be transplanted into the nursery. The seedbed must respond to the two following conditions:

"*First*—It must be free, as much as possible, from stones and roots.

"*Second*—It must be so exposed as not to be injured by the northern winds.

"In that way the plantlets will not be injured by the northern wind, nor prevented by the stones and roots from extending and developing their tender radicles.

"In winter, the ground selected for the seedbed is worked very deeply and is richly manured, employing half decomposed manure, in order that when the seeds are put into the ground it may furnish the elements useful for the development of the new plantlets.

"Toward the end of February or the first days of March, the soil that has been worked and manured in winter is worked again. For this second work the hoe must be used in order to pulverize well the clods and remove the weeds that may have grown. When this is done, the soil is smoothed and disposed in plats, in which afterwards are dug furrows about one foot distant from each other and two inches deep. The seeds, previously prepared according to the method of Gasparin or of Gasquet, are placed in the furrows, maintaining between them a distance of about two and one fourth inches, and taking care that the acuminate part of the kernel remains upward, so as to permit the plumule to shoot forth with more facility and quickness. Lastly, a light layer of garden mold is spread on the sowed soil. When the sowing is finished, the soil is lightly watered, in order that the seeds may come into close contact with the earth, and that there be the necessary moisture for their germination. The watering may be omitted if the soil of the seedbed is sufficiently moist, or if there is appearance of rain.

"During the spring and summer the soil must always be maintained fresh, in order to aid the plantlets to shoot forth quickly, watering them if the weather is dry; it is also indispensable to remove all noxious plants as soon as they appear, otherwise they would defile the soil, greatly hindering the springing up of the olive plantlets.

"By bestowing such attentions on the seedbed, the middle of July will not have elapsed before the olive plantlets begin to shoot forth little by little, continually growing during the summer until they have reached in the autumn a height of about eight inches. When they have attained this height it is well to loosen the soil a little, in order to restore the porosity to the surface, which, by reason of the frequent waterings, may have become compact.

"If, in the locality where the seedbed is situated, the winters are rather severe, the tender plantlets must be protected from the frosts, which would greatly injure them, using for this purpose hay, vine branches, dry leaves, or twigs of evergreen plants.

"During the second year, the attentions to be given the seedbed are identical to those indicated for the first year; that is, it must be watered when needed, to maintain the soil fresh, and it must be weeded repeatedly in order to destroy the noxious plants, to keep the soil soft, and give room to the rootlets to better spread and develop themselves.

"In October of the second year, or, better, during the spring of the third year, the plantlets have reached a height that requires their removal to the nursery; but before going on with this operation it is necessary to cut off from the olive plantlets the small branches that may have grown on their sides, for the reasons that will be explained when speaking of the nursery."

We read in a work by Passerini: "*Multiplication by seed.* This is the most natural system, and the one producing the most hale and robust plants.

"The plant grown by seed has a deep main root, which, descending deeply in the ground, furnishes to the trunk and foliage the necessary moisture, even during the summer dryness.

"Consequently the olive tree grown from seed endures better the summer aridity, and this method of multiplication is to be encouraged, especially in the localities where the soil is loose and rain is scarce during the hot season.

"It is true that the trees grown in this way require more time to bear fruits than the plants produced by ovula; and, besides, they must always be grafted, but the greater productiveness of the trees, the greater resistance to the storms and diseases, counsel to give always the preference to the reproduction by seed.

"To get seeds, it is necessary during the gathering of the olives to select the best formed and those of the most robust variety. It is of no consequence that the tree producing them be of a prolific variety or one very productive of oil; it is only important that the tree be hale, robust, not too young, nor too old.

"The olives having been selected, the pit will be obtained by pressing them, one by one, between the thumb and the forefinger. The pulp may be thrown into the olive press.

"Thus freed from the pericarp, the seeds are carefully washed in water mixed with a small quantity of ashes, and then washed in clear water. After drying in the shade, they are put into boxes to be kept until the following spring.

"About February, or at the latest on the first days of March, the sowing is done.

"In the first place, it is necessary to render the shell of the pits a little less compact, in order that it may be penetrated by the moisture, which is indispensable to the budding. To accomplish this purpose the pits may be immersed for some time in clear water, or in water to which has been added a handful of fresh ashes. But the best result I have obtained was in keeping them for five or six days in water containing a small quantity of chlorine. The latter roughens the shell, appropriating the hydrogen to form chloridic acid, and thus gives access to humidity.

"Instead of softening it, the shell may be advantageously split; not using a hammer, as some have advised, but always an iron vise attached to a table. The longer part of the pit is placed between the jaws of the vise, and by closing lightly the screw, the shell is split. It is not necessary to take out the kernel, on the contrary, it is better to leave it in the cracked shell.

"By this system one can also find out and set aside the empty seeds, which often represent 30 and even 50 per cent of the total.

Seedbed. The seedbed is prepared in the following manner: A piece of land of good quality is selected in a place protected from the frosts, and if possible, near water.

"During the winter the soil is turned up with a spade at a depth of about fourteen inches, and when the earthy particles have felt the beneficial effects of the winter frosts and rains, it is harrowed until it is completely pulverized. In the meanwhile, the soil is manured with well digested dung, to which it is well to add some ashes and potassic chloride.

"Thus prepared, the soil is divided into rather large ridges separated by not very deep furrows.

"On each ridge a layer of pits is spread, placing them very close and nearly in contact with each other if the shell has not been split, and at a distance of about one inch if split. It may appear that the uncracked pits are thus placed too thick, but considering that many of them are empty, and many delay even three years before budding, the thickness is only apparent.

"The seeds are covered with a light layer of earth mixed with well decomposed manure, and upon this is spread some less decomposed manure, full of straw.

"The seed must be immediately watered with a sprinkling pot and the watering must be repeated at least every other day during summer, in the evening after sunset.

"The seeds whose shells have been split begin to germinate in forty days or two months. Those with the whole shell do not germinate until the end of September or in October. But generally, the sprouting of olive trees is not very abundant during the first year, and most of them germinate in the following spring.

"The seedbed must be kept constantly free from weeds; care must also be taken that the surface of the soil does not become crusty.

"During the warm weather it will be advantageous to protect the tender plantlets from the rays of the sun. In winter, if the ground is exposed to the frosts, the young plantlets must be covered, the cover is arranged in such a way that it can be removed during the warmer hours of the day.

"Those who are in need of only a few olive trees, may sow them in large terra cotta pots, that are to be sheltered in winter.

"As the olive trees continue to germinate in certain quantities for over two years, it is well not to destroy the seedbed until the end of the third year.

"The olive plantlets born in the autumn of the first year are transplanted in the following autumn. Although generally the transplantation is made in spring, autumn is generally preferred. *Firstly*, because in the spring the plantlets are more subjected to suffer by reason of the aridity, as part of the roots dry up and are unable of absorption; *secondly*, because by operating in the autumn, the following winter permits the roots to remain well in contact with the earthy particles, before the plant begins to germinate actively; *lastly*, because by transplanting in the autumn, the loss of plants sustained is generally about one half and even two thirds less than when transplanted in the spring.

"The transplantation from the seedbed into the nursery can be done by transplanting when the soil is soft, without minding if the earth adheres or not to the roots.

"*Nursery—Pots.* When the plantlets have reached eight inches in height, they can be removed from the seedbed and placed into the nursery.

"The latter must be situated in a place protected from the frost, exposed to the south, and possess the same requisites as the seedbed, only it must be worked deeper.

"The soil of the nursery must be moderately loose and calcareous.

"The olive plantlets are disposed in squares or quincunx.

"The disposition in squares is perhaps to be preferred, because it leaves between the different rows of plants a kind of small path, thus permitting to easily perform the necessary work, as the hoeing, the grafting, etc.

"During the time the olive trees remain in the nursery, it is necessary to keep the surface of the soil loose and well freed from weeds. During the summer the plantlets are moderately watered when possible.

"In order that the stem may grow straight, all the small branches that come out near the basis, and on the lower thirds of the stem itself, must be removed, according to the degree of their development and strength.

"When the plants have reached a height of eighteen inches they are secured to small canes, which shall be replaced by small posts when their development is greater. The small canes may be placed in position when the plantlets are transported from the seedbed to the nursery.

"The small trees may be grafted when they have attained the age of four or five years, and after two or three more years they may be placed in their permanent abode.

"Instead of putting the olives raised from seed into the nursery, cultivators nowadays place them into terra cotta pots as soon as they are taken from the seedbed. After the plants have remained in these pots one or two years, they are transplanted into other larger pots.

"In the latter case may be used the usual pots for layers. The best are those having two or three lateral holes, besides the one in the bottom.

"The use of pots is commendable for many reasons, especially because it allows the sheltering of the plants during the severe cold of the winter, the grafting and watering them with greater facility, and also to easily put them in their permanent abodes; since by simply overturning the pot, when the earth is not too dry nor too moist, and by lightly striking on the bottom, the plant comes out of itself with its whole earth cake (*pane*).*

"If, by compression of the walls of the pot the roots become felted, they may be somewhat thinned.

"The mode of preparing the pots for the plantlets, taken from the seed bed, is the same practiced for all the garden plants. They are drained, with potsherds placed on the bottom, with a few dry leaves or chips on top,† and then the pots are filled with earth that has been mixed with well decomposed and minced manure.

Dr. F. L. Gould of Santa Barbara, who has had considerable experience in growing olives from seed, says:

"The time required to obtain olive seedlings by the usual method (planting the pits) is long—a year and often more; and in order to shorten this period I cast about to devise a method which should abridge this long interval. I had read of the two suggestions of cracking the stone, and of filing away one end, and the idea struck me that the complete removal of the kernels from the investing shells would be more thorough and quicker at least than filing off the ends of the pits. This plan of removal I determined to try. I cracked the pits in a small hand vise, extracted the kernels and planted them on March eighteenth, and on April twenty-first was gratified to find two little seedlings appearing, and from the last date to the present moment (July second) the little trees have been coming up at the rate of from fifteen to twenty or more a week, so that I now have in the neighborhood of two hundred seedlings, in spite of having lost many by the depredations of snails.

"I fill an ordinary wire box (the bottom of which has been perforated many times by a medium sized bit, to admit of good drainage) with sifted sandy loam, to within three inches of the top, then add one half inch of creek sand, distribute the kernels, and cover with an inch or an inch and a half of sand.

"I find it better to plant rather deep, so that the seedlings may more easily draw themselves out of their investing envelope. It is hardly necessary to add, that the box is kept moist, and carefully shaded all the while.

"At first I thought that olive pits had no suture or division line (so marked in peach, plum, and apricot pits), but I found that close examination of the stem end of the pit showed the existence of shallow grooves, which indicated the line of separation of the sections of the pit.

"These grooves are more noticeable in the fat pits than in the long slender ones, and are of great assistance in cracking in a vise. In a light proportion of cases, by placing these grooves at right angles with the jaws of the vise, the two halves of the pit will fly apart, and thus render extraction of the kernel easy.

"I estimate that a moderately deft-fingered person can easily obtain some six hundred kernels in a day.

"Not all pits contain plump kernels; on this point there is very conflicting testimony, different authorities giving from 1 per cent to 50 per cent of sound kernels.

"I apprehend this divergence is owing to the age of the trees from which the olives were taken. I have obtained results far different, ranging in many carefully counted lots from 40 per cent to 98 per cent plump meats; the older the tree the higher the per cent.

"This method of planting the kernels obviates the necessity of soaking the pits in lye, to deprive them of their oily coverings, a tedious operation and not wholly devoid of danger to the eyes from splashing of the caustic liquid."

At the Quito Olive Farm at Santa Clara, I was shown last spring several olive plants, from four to six inches high, that had come up spontaneously under a grapevine, where pits had been thrown during the olive making season of last year.

INDIRECT PROPAGATION, OR BY OVULE.

"In Italy, in many nurseries, the olive is reproduced by ovule instead of by seed. Olive sowing, with subsequent grafting of the young wild plants, before putting them into their permanent abode, is considered advantageous where high winds prevail. The tree grown by seed can better resist them, because, having a tap root, it can penetrate deeper into the soil. It may be observed, however, that the olive tree obtained by ovule is cultivated without inconvenience also in regions subjected to the winds. Consequently that method of reproduction is preferred, considering that plants raised by seed require more time before they may be planted in the field. In fact, the olive, even when sown according to the best rules, in beds of choice and fine earth, watered when necessary and well kept, is slow and even takes several months in coming forth. One year after its birth, the tender olive plantlet must be transplanted from the seedbed into the nursery, keeping it there until it is developed enough to be grafted with buds, eyes, or scions. The latter method requires such a size of shoot that with the best conditions of soil, climate, and cultivation, the tree needs not less than two years of vegetation in the nursery. Thus from the sowing to the grafting there must elapse three or four years, after which we must yet look out for the development of new domestic branches before planting the olive tree in its permanent abode. However, in the large nurseries, the propagation both by seed and ovule ought to be adopted according to the demands of the cultivators. There are other methods of obtaining new olive trees, but all of them are less reliable. Some persons think it advantageous to rear the shoots in pots, which is known to be a useless precaution and expense, knowing that during the same space of time there can be obtained the best olive trees for planting, although cultivating them in open ground. Only when the soil of the nursery is so loose that the young plants cannot be taken off with their native earth, it being an indispensable condition for transplanting with success in the new cultivations, we may, or rather we are obliged to use pots, from which the plantlets are removed when they are to be planted in the field.

"Those who devote themselves to the industry of olive nurseries must take care that the land selected be possessed of sufficient compactness, so as to be able to transport the plants with their roots protected by the earth lump or cake, without which very few would survive. The exposure and situation of the nursery is also important, it being more advantageous to select a fairly high place on a hill exposed to the southeast or southwest, rather than a low valley and other exposures.

"For the success of the young olive trees in the field, it is necessary that the soil of the nursery be not too rich or fertile. Persons should not purchase trees grown in soft fresh soil saturated with manure, as they could not thrive in their permanent abode, which generally is situated on stony, poor, and dry hills or rising ground.

---

*The system of many gardeners of raising the olive plantlets in pots without interring them is not to be commended. In this manner the plants become accustomed to frequent waterings, which, after they are put into their permanent place, could not be continued. Deprived of such watering, the plants suffer greatly, and many die.

†Chips of unvarnished terra cotta, or, instead of dry leaves and chips, there may be used calcareous or limy fragments.

"The soil for the nursery must be broken up during the proper season, at a good depth, removing from it, if there are any, the weeds, roots, stones, and other rubbish. After breaking, it is well to let it rest for several months; then it is turned up with a spade, manuring it abundantly with normal stable dung, and if it be too argillaceous or strong, this would be the proper time to correct it by a mixture of sand, sifted rubbish, garden mold, and like materials. If, on the contrary, the soil is too loose, I do not think it would be convenient to seek to improve it, as the expense would be more than the price of the land. It is better to select, if possible, another tract; the more so, that with the constant working that a nursery requires, the soil becomes light in time, even if at first it was rather compact. It is obvious that the plantation must be divided in regular squares, separated by paths which may also serve as drains for rain water. The partition of the soil is advantageous in order to easily do the continual works that are required. Although an excessive watering must be avoided, not to accustom the plants to a too active life, when afterwards they must live more soberly, yet they must be watered in a certain measure; consequently, it is necessary that the nursery be provided with water.

"The belief that the olive trees, cultivated from their birth in one locality and transported permanently into another, are liable, because of the change of air, to waste away, has no foundation (in a zone where the olive tree thrives, the difference cannot be such as to prevent its so called acclimation). What is important is that the olive plantlet be not grown in a too rich soil, because in that case it cannot always (on the contrary, rather seldom) be planted in a better soil. Hence the necessity of forming a soil of middling fertility, thus preventing also, after a period of years, the modification in the quality of the soil in the nursery itself. Besides, it is well known that, by growing constantly the plantlets in the same soil and removing the adult ones surrounded with earth, it impoverishes the soil itself. This is avoided by the above system, because the soils necessary to form that of middling fertility are brought from the localities where are found the different quality, and thus the cultivation of the plantlets may be continued indefinitely on the same element."

PROPAGATION BY SIMPLE AND RAMIFIED SLIPS.

Aloi writes: "The simple slip is a piece of olive branch about eighteen inches long, which is planted in the soil by its larger end. The slips must be detached from fruit-bearing trees of good quality; they must be strong and vigorous, with the bark thick and pithy, and provided with gems from which the issuing of shoots and roots may be easy. In order that the slip may turn out well, it must be developed in a nursery having the same exposure as the tree from which it was detached.

"Having cut the slips and before preparing them, there are made holes in the nursery to place them, using a long dibble. In making the holes care must be taken not to twist the dibble, nor to incline it to the right or to the left, because it would harden the sides of the hole, which must remain soft as much as possible. A sloping cut is made in the lower part of the slip to be put into the ground, and another cut slightly inclined is made in the superior part; then the twigs are overlaid with cow dung and rolled in good garden mold.

"Then they are placed into the holes by the end having the sloping cut, leaving out of the ground a length only of about six inches, and some good garden mold is so arranged all around that the gems may be in perfect contact with the earth. The outside cut is smeared with some mastic to preserve it from humidity. The higher underground part of the slip is to be surrounded with two to three inches of ashes and fine earth mixed together.

"The same rules and precautions as before described for the simple slips, are to be put in practice for the ramified twigs.

"The ramified or composite twig differs from the simple slip in that it is provided with small branches.

"The composite twig must be planted at first in a provisional nursery, and only when it has acquired shoots and roots is it transported into the true nursery. When the composite slips have received the same attentions that are prescribed for the simple slips, they are interred in the provisional nursery horizontally, the larger end lower than the small one, leaving their small branches one half of the length out and one half within the earth.

"After the first year, the outside branches having put forth leaves, and those within the earth small roots, the composite slip is extracted and divided into so many pieces as there are branches, and each of these is transplanted into the true nursery, where they are attended to in the manner described.

PROPAGATION OF SUCKERS.[*]

"Between the roots at their insertion with the trunk, and on the large roots running on the ground, a great number of suckers are often developed that can be turned to advantage for the propagation of the olive tree; it is even the quickest manner to propagate it. For the most part these suckers are provided with roots; if they are in great number, they are thinned out, leaving the most vigorous and strong, and covering them with earth, in order that those without roots may be rooted.

"On the following year they are detached from the mother plant and transported into the nursery, where they are planted."

XI.

VARIETIES OF THE OLIVE TREE.

From the single European *Olea* there issued so many varieties of olives that to-day their number is not reckoned. They were produced by means of fecundation,[†] or by the various conditions of climate and soil where its cultivation was introduced, and also, as all other plants, both herbaceous and arboreous, by good cultivation. For the same reasons, however, many of these varieties did not nor do they now maintain themselves perma-

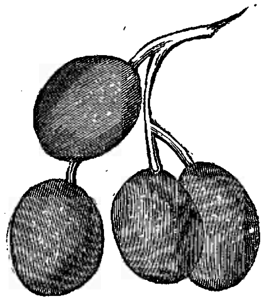
---

[*] The suckers are the gems that have germinated spontaneously between the roots, at their insertion with the trunk, and on the large roots running on the ground.

[†] Baron Vincenzo Ricasoli, in the Bulletin of the R. Tuscan Society of Horticulture, July, 1880, treats partly of this fecundation:

"The fecundation of the plants, in order to obtain varieties in the flower, fruit, leaves, and consequently in the plants themselves, is accomplished in many ways and by different means; and the student of natural sciences is seeking continually, with favorable success, the truth, and explaining the hidden phenomena of the vegetable kingdom.

"An important agent of the fecundation of some plants, is the wind that transports the pollen from the flower of a plant to the flower of another, and even at a great distance nently, while others did; consequently each oleiferous region has its varieties of olive trees with their own characteristics, some being noticeable for the height of their trunk, some tending to have constantly long, nearly straight ascending branches, and some, on the contrary, keeping low their trunk and having their branches inclined in such a manner that their foliage assumes a fine round form.



GIOGLIAIA.

Other varieties of trees are dressed with larger or smaller foliage, more massive or thinner, darker or lighter, and produce fruit of different form and size, more or less fleshy, more or less rich in soil, of greater or less degree of fineness and transparency, or with a pulp of more or less delicacy when used as an eatable fruit. Lastly, different other varieties are more or less productive, and more or less resistive to the winds, to the drought, to the frosts, and storms in general.

Those changes have caused a general increase of the said varieties, and explain how the most ancient writers knew only a few, and extolled some of them, which, by reason perhaps of the modifications to which they were subject, by the different conditions of soil, atmosphere, and cultivation, or by reason of the changed locality of their abode, are now unknown. In the useful report on the conditions of agriculture in Italy for the years 1870–71, published by the University of Agriculture, Industry, and Commerce, there are set down three hundred varieties. This number, for the reasons already explained, ought to be materially reduced, after a well done rational work on classification.

The varieties of the domestic olive tree ought to be divided only into two classes, each of them divided also in two sections, that is:

Class 1. Section 1.

Variety of olive tree whose stem tends to a great dimension, that has curved branches, whose leaves are of a light red color or finely ash-colored, with a rather large fruit, the pulp of which is delicate and the production of oil perfect.

In this category should be included the olive tree producing eatable berries. These varieties require a favorable exposition; that is, they must be protected from the winds, and have a constantly mild climate and a fertile soil, which favorable dispositions are enjoyed here by the *Correggiola* or *Frantoia*, the *Grossaia*, the *Razza*, the *Razzola*, the *Oriola*, etc.

Class 1. Section 2.

Variety of olive tree tending to smaller dimensions, having curved branches, leaves of a light red color or finely ash-colored, rather small fruit, producing good oil. These varieties do not require a constantly mild climate, and adapt themselves to a variable one, and to expositions subjected to the winds, and thrive in less fertile soil; as, here, the *Weeping*, the *Mignola* or *Gremignola*, etc.

---

accomplishes the delicate mission. Another very important agent is generally the intervention of animals. There are flowers so strangely shaped, and whose structure is so complicated, that they could not, by themselves alone, accomplish the functions that are absolutely necessary in order to prevent the degeneration or the extinction of the species to which they belong."

Class 2. Section 1.

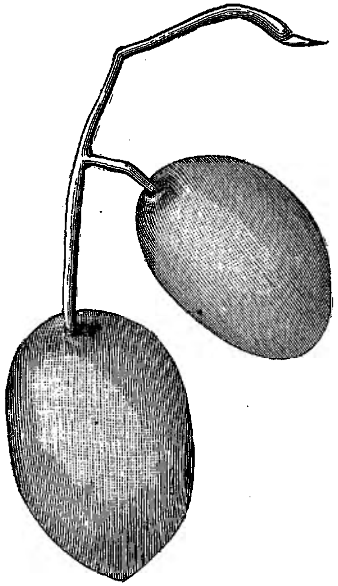
Variety of olive tree tending to large dimensions, with a strong bearing of straight branches, dark or dirty green, large olive, less delicate pulp, and the oil production rather common. These varieties stand a climate less constant, and the highest and coldest expositions, but require a rather fertile soil; as the *Moraiola* or *Morinella*, the *Leccina* or *Leccia*, the *Morchiaia*, etc.

Class 2. Section 2.

Variety of olive tree tending to small dimensions, with robust bearing of straight branches, leaves of dark or dirty-green color, small fruit, pulp not abundant nor delicate, scarce production, and common oil. These varieties stand an inconstant climate, the worst positions, and a dry or cold soil; as, in this region, the *Puntarola*, the *Trilla*, the *Selvatica*, the *Oleastra*, etc.

This classification, which may be considered the most rational, may also be subordinate to modifications; yet it would not do to dissent from what Professor Caruso has written in his monography, where he justly observes that no attention ought to be given either to the form or to the color of the fruit, they being nearly always negative characteristics when a comparison is made. He adds:

"A good and rational classification of the varieties, uniting simplicity to clearness, must put any one in position to appreciate and select olive trees according to their agricultural requisites. It is not of much interest to the agriculturist to know that a variety bears olives of this or that form or color, or that its leaves are more or less abundant, more or less developed; whether they are large or small, and the fruit is red or black, round or oblong. This does not give a clear idea of the nature of the tree, of the place where it ought to be cultivated, of the manner of pruning that suits it best, of the distance it requires in planting, of its fecundity, etc. What they want above all is the knowledge of the characters that show the resistance, the bearing, the stature, the precosity, the fruitfulness, and the oiliness of the tree.



SANTA CATERINA.

"The degree of resistance permits us to judge whether a plant can thrive in unprotected and non-temperate places, in unpropitious localities, or it demands the most favorable exposures, the positions well protected.

"The bearing of erect and robust or of thin branches, numerous and reflected, suggests the form that the tree will have and the pruning that it requires to bear abundant fruits.

"A great height, or medium, or small, tells us what area we must allow to each tree, and the proper distance, that it may grow and produce. It is generally remarked that the height is proportionate with the domesticity. The wild olive trees are ten to fifteen feet high; the hardiest cultivated plants make medium trees; those less hardy, larger trees; the trees of the highest stature are the best olive trees, in proper situations.

"The degree of precosity in blossoming and maturing of the fruit is a good indication for valuing the fruitfulness of the tree, because the early blossoming is a guarantee of certain fructification and of prompt maturity that permits to rescue in time the product from any vegetable enemies.

"Lastly, the oiliness teaches us to prefer those olives which at equal weight, give more oil.

"With this data as directing principles, we may be able to embrace all the varieties of the olive tree in four groups, forming two divisions, that is:

"*Division 1. (Oleasters.) Group 1.*

"Represents the wild type, which is not worth cultivating, because the berries are very small and very little fleshy. Shrub or tree ten to fifteen feet high.

"*Division 2. Cultivated Olive Trees. (Olivastri.) Wild Olive Trees. Group 2.*

"Obtained from the seed of the best olives; the hardiest of the cultivated olive trees; small branches, robust and erect; berries of different size, but not much fleshy. Tree generally not very high, sometimes very showy.

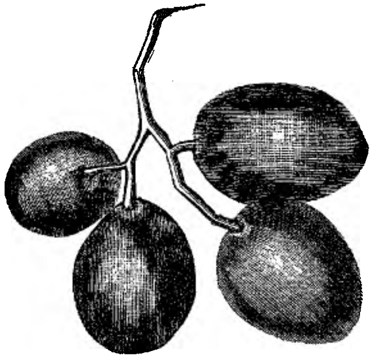
"*Medium Olive Trees. Group 3.*

"Less hardy; small branches, robust and erect; berries more fleshy. Tree of middle height.

"*Frantoiami. Group 4.*

"The best; small pendulary branches; berries of different sizes, very fleshy and oily, sometimes lacking oil and good only for pickling. Large tree, that produces mainly olives for oil.

"The first division treats of the *Oleasters* (the *Olea europ.*), which, although they form their fruit well (*Allegano*) and yield a crop, cannot be cultivated with profit, because the small berries have the mesocarp very thin and give but little oil, representing thus a barren type, a good subject to be grafted. They constitute a unique group, including few varieties, different in height, form, and the size of the fruit.

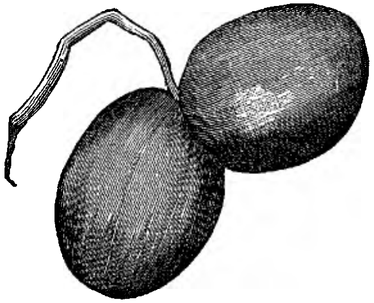


LECCIA.

"The second division is that of the cultivated olive trees and includes three distinct groups: the *Olivastri*, the medium olive trees, and the *Frantoiani*. The *Olivastri*, obtained at first from the seed of the best varieties, form the group of the hardest and less oily cultivated olive trees. The *Frantoiani* represent the group of the noblest and fruitful group of olive trees. Between the two there is interposed, for hardiness and productiveness, the group of the medium trees.

"The *Olivastri* are distinguishable by their bearing of erect and ascendant small branches, by the foliage of darker color, and because they require severe pruning. They stand a poor soil, the winds, the fogs, and the frosts of the locality. They form well, bear olives varied in size, not much fleshy, consequently producing oil in limited quantity; the largest may be pickled.

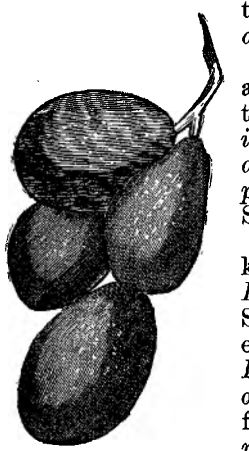
"The *Frantoiani*, or trees truly oleiferous, send forth thin tender shoots, long peduncles, and must be sparingly pruned; their foliage is light; they prefer protected positions, sunny exposures; fear the fogs, the winds, and cannot stand the frosts; if the year is propitious, they produce well. The fruit varies in size; pulp abundant; oil fine, very pleasant; at times they contain but little oil, and must be pickled.



ST. AGOSTINO (Green olive).

"The medium olive trees resist better than the *Frantoiani* on high and cold localities; branches ascendant, but less robust than those of the *Olivastri*. Olive of various sizes, less fleshy than the *Frantoiani*; richer in pulp and oil than the *Olivastri*.

"The cultivated trees which belong to the second group (*Olivastri*) are, in Tuscany, the *Olivastri*, *Leccini*, *Mignoli* or *Gremignoli*, *Puntaroli*, *Trille*, etc.; in Sicily, the *Ulivastri*, *Cerasoli*, *Nervi*, *Crasturaffi*, etc.; in Calabria, the *Ultra prima*, *Coccitani;* in Puglia, the *Cellinio*, *Leccesi*, *Scuranesi* or *Uardo;* in Liguria, the *Salvatici*, *Mortini* or *Mortegui*; in the lower western region, the *Colombari;* at Sestri Ponente, the *Mattari* or *Olivastri*, etc.



BELMONTE.

"Included in the third group (medium olive trees) are, in Tuscany, the *Moraiolo* or *Morinello;* in Sicily, the *Caltabellottese* or *Palombino*, *Bianchetto* (*Biancoliddu*), etc.; in Calabria (Piana di Palme), the *Rotondello* or *Ottobrarico;* in Puglia, the olive tree of *Monopoli;* in Liguria, the *Merlino* of Alberga, *Pignolo* of Savona and Rapallo, etc.

"The fourth group (*Frantoiani*) includes the trees known in Tuscany under the name of *Frantoiano*, *Frantoio*, *Razzo*, *Razzolo*, *Grossaio*, *Coreggiolo;* in Sicily, the *Ugghiarn*, *Nebu* or *Zaituni*, *Calmignaru*, etc.; in Calabria, the *Mammola*; in Puglia, the *Paesano* of Bari, or *Barezano*, *Ogliarolo*, and *Racinoppe*, of Corato; in Liguria the trees called *Tagliaschi*, from Finale and Voltri; *Pignoli*, of Oneglia, *Lavagnini* of the Riviera Levante, *Razzoli* of Sestri Ponente, of Levanto, etc.

"In Tuscany forty varieties have been enumerated as follows:

VARIETY.	ORIGIN.
1. American (so called)	Aretino.
2. Amerina	Cortona.
3. Bacolina	Valley of Nievoli.
4. Bastardona	Pisan Hills.
*5. Belmonte†	Florentine Hills.
*6. St. Caterina (eatable fruit)	Florentine Hills.
7. Cerretana	Valley of Nievoli.
*8. Coreggiola	Florentine Hills.
9. Cucca (eatable fruit)	Florentine Hills.
10. Dolce (sweet) (eatable fruit)	Florentine Hills.
11. Francese (French) (eatable fruit)	Pisan Hills.
12. Frantoiana	Florentine Hills.
13. Gentile (fine) (eatable fruit)	Florentine Hills.
*14. Giogliaia	Amiata.
*15. Gremignola	Pisan Hills.
*16. Grossaia	Pisan Hills.
*17. Leccia	Pistoia.

Variety.	Origin.
18. Leccia piccola (small)	Florentine Hills.
19. Maremmana	Siena.
*20. Mignola	Florentine Hills.
*21. Mignola (large olive)	Valley of Nievoli.
22. Moraiola grossa (large)	Maremma.
*23. Morchiaia	Florentine Hills.
*24. Morinella	Florentine Hills.
*25. Mortellina, or Trilla	Valley of Nievoli.
*26. Occhina, or Puntarola	Valley of Nievoli.
*27. Ogliara	Valley of Nievoli.
*28. Olivastra	Amiata.
29. Orida	Maremma.
30. Pallona	Valley of Nievoli.
31. Perugina	Cortona.
32. Pesciatina	Valley of Nievoli.
*33. Piangente (weeping) ‡	Florentine Hills.
34. Pillora	Pisan Hills.
35. Pocia (eatable fruit)	Cortona.
36. Ragiale	Cortona.
37. Rastrellina	Cortona.
*38. Razza	Pisan Hills.
*39. Rossellina	Florentine Hills.
*40. Salvatica	Littoral of Maremma.

"Having thus begun the study of the varieties of the region, there ought to be grafted at the same time in each locality, the varieties of the other regions, so that it could be possible to ascertain the character of each variety, and how they are modified by the change of locality."

The main varieties known to-day in the different Italian provinces, are the following:

In Tuscany.

1. The *Razzo* or *Frantoiano*.
2. The *Frantoio*, *Grossaio*, and *Coreggiolo*.
3. The *Morinello* or *Moraiolo*.
4. The *Mignolo* or *Gremignolo*.
5. The *Leccino* or *Leccio*.‖

In Sicily.

1. The *Ofliaia*, or for oil (*Ughiara*, *Ughialora*).
2. The *Neba* or *Zaituni*.
3. The *Calamignara* or of *Termini*.
4. The *Caltabellottese* or *Palombina*.
5. The *Bianchetta* (Biancoliddu).
6. The *Cerasola*.

In Calabria.

1. The *Mammola* or *Mammolese*.
2. The *Ottobrarico*.
3. The *Rotondello*.
4. The *Coccitano* or *Coccitanico*.

In Puglia and Basilicata.

1. The *Paesano* at Bari, *Baresano* in other places.
2. The *Ogliarolo* or *Da olio* (for oil).
3. The *Racemi* or *Racinoppe*.
4. The *Monopolese* or of *Monopoli*.
5. The *Cellino*, *Laccese*, *Scuranese* of *Nardo*.

In Umbria.

1. The *Raso*, *Ragghio*, or *Raggio*.
2. The *Tondo* or *Tondulo*.
3. The *Fecciaro*.

In Liguria.

1. The *Taggioso*, *Taggiasco* or of *Taggia* in the Riviera di Ponente, *Lavagnino* or *Razzolo*, Riviera di Levante.
2. The *Pignolo*.
3. The *Colombaro*.
4. The *Mortino*.

In the Basin of Garda, in Trent, and in the Provinces of Verona and Brescia.

1. The *Casalivo*, *Casali*, or *Nostran*.
2. The *Razzo* or *Razzar*.
3. The *Gargnan*, *Gargna*, *Grignan*.
4. The *Drop*, *Forte*, *Tombolot*.
5. The *Favarol*, *Favar*, *Fofognon*.

The white olive of Ascoli, illustrated by Professor Castelli in a pamphlet entitled "The White Olives of Ascoli in the Olden Times." He says: "A noble citizen of the Marche, the lamented Count Spada, while dining in a restaurant at London, noticed on the bill of fare the olives of Ascoli. Wishing to taste these delicious fruits, which do honor to their region, he ate some

---

*The following varieties bearing eatable fruits, are added: *Sant. Agontino* (Audria), *Bella di Spagna*, and *Ascolana*.

† This beautiful variety is similar to the olive *Razza*, and to the olive *Racinoppe;* it is very prolific and produces excellent oil.

‡ This excellent and beautiful variety is believed to be a large fruit (*Mignola*), is highly recommended for the hills, because it stands better than the variety *Leccia* on poor and dry soil; it has given proof of hardiness, and produces oil of fine quality.

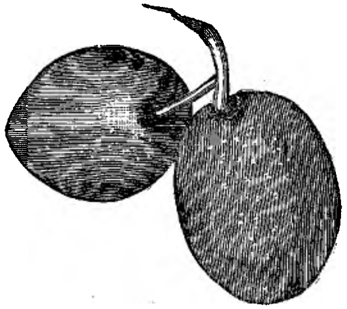
‖ "In 1872 (*Agricoltura Italiana*, of December, 1877), after a frost that caused considerable damage to the olive trees, the Board of Agriculture of Florence appointed a Commission to visit the damaged localities in order to study the injuries suffered by the plants, and the reason why, while some groves had died, some others contiguous to them had remained unhurt; and possibly to suggest to the olive growers what they could do in regard to the losses they had suffered.

"I had the honor to belong to that Commission, and from the careful examination we made, our attention was called to the following fact that we noticed in two localities: At Poggio, in the middle of a grown up grove of olive trees, that formerly was magnificent for vigorous vegetation and now almost wholly destroyed, a single plant was green and prosperous. The injured plants belonged partly to the varieties *Frantoiana* or *Coreggiola*, partly to the *Morinella* or *Mariola;* the one that remained unhurt was known by the name of *Leccino*. We noticed the second case on the hill of Pietra, where a tree of the variety *Leccino* had remained unhurt in the middle of the nearly general destruction of the other varieties.

"After further investigations we heard that in the Province of Pistoia this variety was preferred by the cultivators of those regions, because it is more hardy in the low temperature that is so frequent in that district. In fact, we found that since twenty years they had commenced the substitution of the *Leccino* tree to the old variety of olive trees.

"The *Leccino* tree requires a fresh and very fertile soil, and its virtues cannot be guaranteed in other conditions, because the plants of this variety not planted in such soil do not succeed. In fact, two plants grown from the seed 1872, grafted to this variety in 1876, and planted permanently in 1877, one near the other, during the first years the two trees grew on equal conditions, but while one of them, planted in high ground and not having found obstacles, became in a few years, without any aid, fine and majestic, with a beautiful dark green foliage, and bore fine olives; the other, which was planted in a lower ground, meeting perhaps obstacles in some stony underground strata, became also a fine tree, but its foliage, its color, even the olives, show the diversity of the conditions of the soil where it grows, notwithstanding its being assisted by frequent manuring, and also watered in summer. This variety must not always be considered as the hardiest to cold as this quality is subjected to the hygrometrical conditions of the soil."

of them, but found when settling the account that in the English metropolis the white olives of Ascoli cost about 20 cents each. They cost nearly the same in Paris and are considered a delicacy for the rich. It must not be thought, however, that all the olives consumed in London, Paris, and other cities come from Ascoli. As is the case with all commercial products of high reputation, the goods are named after the locality that gives them more credit than favor.



ASCOLANA (Green olive).

"In Ascoli the price of the pickled olives, put in proper recipients for distant exportation, varies from $3 to $5 per pound. The quantity is about one half consumed on the place. During many months of the year the white olive ends the meal of the well-to-do families of Ascoli. Stuffed with meat and other ingredients these olives are also an appetizing dish. This small industry handsomely remunerates many producers.

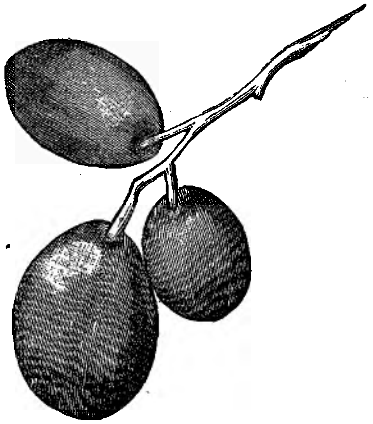
"*First*—That of the properly called tender olive (*Oliva tenera*) is rather large, nearly round, pale of color, with a very small pit, and generally flat.

"*Second*—That of the nive olive (*Oliva gentile*), with a little larger pit, of more oblong form, and of pea-green color.

"*Third*—That of the hard olive (*Oliva dura*), whose volume oftener equals that of the two preceding qualities; but it differs by its lengthened form, by the dark green of its surface, by its larger ovoidal pit, and by its rather hard and tough pulp.

"Generally for the first and the second grafting, selection is made of gems taken from plants that produce olives of the first or second quality; that is, the tender and the nice, keeping an inverted order; that is, placing buds of the first quality on shoots of the grafts produced by gems of the second.

"The less followed system, but, as has been shown by experience, the more fruitful, is that of using in the first grafting the gems of the hard olive (*Oliva dura*), and in the second those of the tender (*Tenera*) olive. After all, the other processes practiced in the oleiferous regions for the cultivation of the *Olea europea* and its varieties, are useful also for the olive tree grown for its fruit. It has been found advantageous for the latter to frequently water the shoots of young grafts, and even the grown up trees, during summer. A sure reward for this work will be a more abundant crop of choice olives."



RAZZA.

Another fine variety for pickling purposes is called *Bella di Spagna*. A variety discovered in Greece by Professor Orphanides. Its fruit is white, that is ivory white, tending to yellowish, and its foliage is of a fine light ash-colored green on the upper face, while the under face is of a fine nearly silvery gray. All these characters constitute a variety truly distinct and ornamental. This olive was exposed at the World's Fair of Vienna, and at the Subernational Horticultural Fair of Florence, under the name of *Olea lencocarpa* or *Chion-carpa*. Its oil is very fine.

Professor Casabuona writes: Many are the varieties of the *Olea europea** cultivated in the different oleiferous regions of Italy, and to exactly describe them would be hard and difficult. In order to bring them to the knowledge of the cultivators, I will confine myself to the principal varieties, and those best adapted to the Italian soil, those which combine facility of cultivation with abundance of production.

Olea amygdalina.—Amygdaline olive tree, resembling the almond (mandorline), known in Southern France by the name of *Plant d'Aix.* This is one of the finest and best varieties, and is extensively cultivated in Provence. Its fruit has the form of the almond. It is used for preserving, but it could be also converted into oil, as the oil it gives is sweet and of good quality.

Olea augulosa.—Olive tree Galliningo, resembling the laurel; stands well our hardest winters; its foliage is not very dense. The fruits are reddish, provided with a long peduncle, and are preserved in vinegar. Its oil is of middling quality.

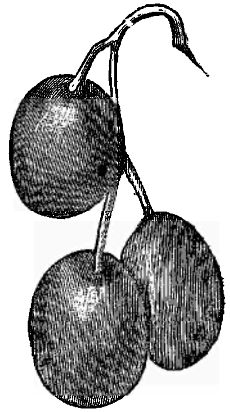
Olea atrorubens.—Reddish olive tree.

Olea colombaro.—A tree of middling size; it fears the frost; prefers a stony soil and calcareous localities. Its fruit is of a fine dark violet color, is small, abundant, and produces the finest oil.

Olea atrovirens.—Pointed olive tree, known in France by the name of *Punchude* and *Rougette.* Its fruits are pointed at the extremities, and when perfectly ripe are orange colored like the fruit of the jujube tree (*Zizyphus vulgaris*). It produces oil of good, but not of the first quality.

Olea cranimorpha.—Olive tree (sorbaio) resembling the service-tree, known in France under the name of *Cormean* (sorbe) and in the Ligurian localities, under those of *Lavagnino* (from Lavagna) and of *Taggiasco* (from Taggia). Its branches incline toward the ground, and as it increases in volume the tree assumes a picturesque appearance; it could therefore be cultivated also as an ornamental plant. This is one of the best and most productive varieties; small fruit, elongated, very black when ripe; pit pointed at both extremities.

Olea reispanica.—Olive tree of Spain, *olivotto* (small olive tree). Its fruits are the largest of all the varieties; excellent for preserving purposes; if converted into oil they would give a bitter oil. In Seville there is cultivated one of its under varieties, known under the name of *Aceituna De la Reina* (olive of the Queen), that is preserved and is of the size of a Damson plum. Its pit is very small.



ROSSELLINA.

Olea oblonga.—Elongated olive, known in Provence under the name of *Picholine* and *Saurine*, and in Italy under the name of *Pignolo.* Its fruit is considered the best for preserving purposes, and is also dried; it produces a fine and sweet oil. According to the distinguished Rosier, those names are given also to another variety having the qualities of the *Olea oblonga*, whose fruit is a little smaller, of a more round form, and has the pulp strongly colored. In Liguria this variety is called *Crova.*

---

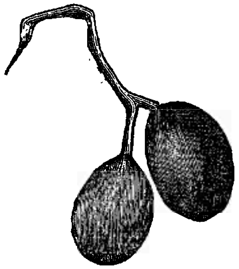
*By the name of varieties are called those alterations and changes that often are seen both in the flowers and fruit, in the leaves, and in other parts of the plants obtained from the seed of a type species.

Olea odorata.—Blue olive. Elegant plant, with large and numerous leaves; elongated fruit, possessing a pleasant aroma; it is excellent when preserved, but it does not last so long as the others of its kind.

Olea praecox.—Black olive, Moorish olive, blackish olive. This variety produces very black oval fruits, from which is extracted an oil that is considered of the best; small pit.

Olea regia.—Royal olive, known in France under the name of *Triparde.* Produces excellent large fruits for preserving purposes; if converted into oil, the oil would be of the worst quality.

Olea racemosa.—Branchy olive tree, known in southern France under the name of *Bouteillac*, *Boutiniane, and Nepugete.* This plant is not much sensitive to frost, stands our most severe winters, but its production is very variable. The oil is good, but it has the great disadvantage of depositing considerable sediment, the fruit having a very fleshy pulp.



GREMIGNOLA.

Olea spherica.—Spherical olive, *barralingo* olive tree. Plant of fine vegetation, whose fruits are more rounded than any other species and variety, and from which a delicate and fine oil is obtained.

Olea subrotunda.—Olive nearly round. Robust plant of fine growth and abundant production. Fruit small, very bitter, giving an excellent oil.

Olea variegata.—Variegated olive, marbled olive tree, whose fruit varies in form and color, passing from green to red, and from the latter to violet beautifully speckled with white; oil of middling quality.

Olea viridula.—Greenish olive, oval fruit, that keeps for a long time its green color, but subject to putrefy at the time of its maturity. This variety enjoys a very good reputation at Port Saint Esprit (district of Avignon), but is not cultivated in any other locality. This may depend upon the soil, the climate, and also upon the method of cultivation.

The characters of many other cultivated varieties could be described, but I think that the foregoing are sufficient; however, I will name two more: the sweet black olive (*Olea nigra dulcis*) and the sweet white olive (*Olea alba dulcis*), because their fruit, when well ripe, do not require, to be eatable, so careful preparation as the other species, being of excellent quality for pickling purposes.

Nothing remains to be added in regard to the utility of the explained matters, but being desirous to unite the pleasant with the useful, I shall yet entertain the kind reader on the ornamental species of olive trees that serve exclusively for the embellishment of the gardens, and for the botanical collections:

Olea apetala.—(Hort. angel. Vahl. Pers.) Olive without petals. This species is a native of New Holland; has elliptical oval leaves, quite entire. The flowers, without petals, as its name indicates, are disposed in bunches. It is cultivated in conservatories.

Olea americana.—Olive tree of America. It is found in the Carolinas and Florida. It is an erect plant, with leaves lanceolate, elliptical, rather oblong, pointed, smooth, entire, solid, glossy on the upper face, and of a fine yellowish green. It blossoms in June; its flowers are arranged in close bunches; its bracts are persistent, united, and small.

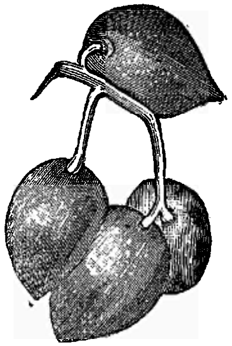
Olea capensis.—Olive tree of the Cape of Good Hope. Very dwarf and bushy plant two feet high. Its branches are rough, whitish, tetragon; leaves opposite, oval, rounded, very large in comparison to those of the European varieties; quite entire, solid, stiff, of a fine, dark, and gloomy green on the upper face, pale on the under face. It blooms at different times; small, white flowers, disposed in elegant and showy divergent bunches. One variety only, with elliptical, wavy leaves, and green pedicles, is cultivated.

Olea emarginata (Lam.).—Emarginated olive, called, in India, *Ponnei.* Originally from India and Madagascar; tree of about sixty feet in height, whose branches are opposite, gray, and striated; has the leaves opposite, oval, rounded, notched at the summit, quite entire, solid, wrinkled, of a fine lively green on both faces; the pedicle short and wrinkled. Flowers larger than those of all the other species of this class, bell-shaped, in four small divisions, beautifully disposed in terminal bunches.

Olea exasperata (Jacq.).—Rough olive tree, originally from the Cape of Good Hope, blossoming in May. Bushy plant of about five feet; erect and dark branches; leaves opposite, oblong, obtuse, with a point, quite entire, solid, glaubrous, five to six inches long. Numerous white flowers in trichotomous and terminal flowery tufts.

Olea excelsa (H. K.).—Olive tree of Madeira. Small plant having an erect, gray, and branchy stem. Leaves lanceolate, elliptical, pointed, and not smooth like the *Olea americana*, but with the edges reflected, quite entire, solid, shining, of a dark green color on their upper face. Flowers in dense bunches; the bracts leafy, the flower cup-shaped and persistent, the higher caducous, large, and leafy.

Olea fragrans (Thumb.)—*Osmonthus fragrans* (Lour).—Odoriferous olive tree, (*Odoriferous osmanthus*).* From China and Japan. Tree measuring three to six feet; having branches more flexible than those of the other olive trees.



TRILLA.

Thumb (*Osmanthus fragrans* Lour).—A native of Japan and China. This plant is now too well known to require a description, but it may be seasonable to give some particulars about it that, perhaps, are not so well understood.

Although always green, and consequently more exposed to feel the injuries of the snow and frost, the *Olea fragrans* may be said to possess a degree of endurance of cold rather greater than the common olive and its compatriot, the camellia. Contrarily to the latter, the *Olea* grows equally well in the shade, in places short of light, without ever seeing the sun, or in a full southern exposure; it does not require, as is generally believed, manured soil, but thrives in any good common soil. As far as we know, it does not produce fruit in our country (we should be grateful to those able to contradict this assertion). It is propagated by shoots, and oftener by grafts or slips that are made in summer and take without difficulty. The plants obtained in this manner bear blossoms even when very small.

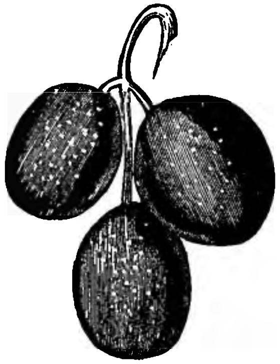
---

* The following is quoted from the "Bulletino" of the R. Tuscan Society of Horticulture, of September, 1876:

"Whoever, nowadays, goes via *Servi* and many other streets of our Florence, cannot but feel a pleasant surprise at the sweet perfume that fills the air, nearly making it more respirable and purer. Rather different, indeed, are the effluvia which we are often condemned to inhale in the city. And that delicate perfume, not too strong to be annoying, comes from the minute flowerets of a plant sister to our common olive tree, the *Olea fragrans.* Leaves opposite, lanceolate, pointed, very large, denticulate, and very solidly coriaceous. From July to August it is decked with white, sweetly odorous flowers, gathered in twos or threes in the axils of the superior leaves, and supported by short peduncles. These flowers enter as a special perfume into the preparation of tea."

The *Olea fragrans* may also be propagated by grafting it on the olive tree or the privet, especially on the *Ligustrum japonicum*; and we advise the amateurs who possess large privets in their gardens to try the experiment, thus substituting a very sweet perfume to the too sharp and not always pleasing odor of the privet flowers. One could take advantage of the numerous flowers of the *Olea*, as they do in China and Japan, where they use them for scenting certain qualities of tea.

We shall add a few words finally, concerning a species akin to the preceding one and much less common, the *Olea ilicifolia* (Hort.), *Osmanthus aquilifolius* (Hort.), a native also of Japan, that seems to show such characters as to truly constitute a distinct species. Under many aspects, the latter seems to be preferable to the older species, from which it differs by shining, varnished-like leaves, of a fine dark green on the upper face; while the under face is smooth, finely veined, and of a lightly opaque green color. These leaves are nearly all notched in such a manner as to be mistaken for those of the holly, but they are not wavy; we say nearly all, because sometimes there can be found some that are entire and completely unarmed. The flowers of this species, arranged around the small branches of the preceding year, are, as in the other species, of a snow-white color, and consequently very conspicuous. Their perfume is also very different and puts in mind that of the *Gardenia;* and it is a curious fact that, while close by its perfume is much stronger and penetrating than that of the *Olea fragrans*, it does not spread at a distance like the latter.


OLIVASTRA.

Another well known species, or variety, is the *Olea rubra*, which resembles very much the *Olea fragrans;* its leaves are larger and its bearing is also more arborescent, but it produces scanty flowers, and its flowerets are very small, and do not differ from those of the more common species. In various catalogues are indicated various other species and varieties of olives (*Olea*), referable probably to divers forms of the species.

Olea serratifolia (Hort. angl).—A native of the Cape of Good Hope, with leaves indented like a saw.

The *Olea capensis* can live in open ground when in a good exposure, in a light and sandy soil. But as a rule, this tree rather belongs to the conservatory than to the open field. These olives require a good soil, somewhat sandy, and need but a few waterings during winter. They are obtained, ordinarily, from seeds sown over a bed of manure. They are also propagated by layering, which takes root at the end of two or three years; they are multiplied, besides, by cuttings set into vases immersed in a hotbed, where they grow under glass, shaded by small branches.

The *Olea emarginata* is purely a hothouse plant. The *Olea serratifolia* and *Apetala* have been introduced into England some time since.

There are known also:

The *Olea chrysophylla.*
The *Olea floribunda.*
The *Olea arborea.*
The *Olea ilicifolia.*
The *Olea ferruginea.*

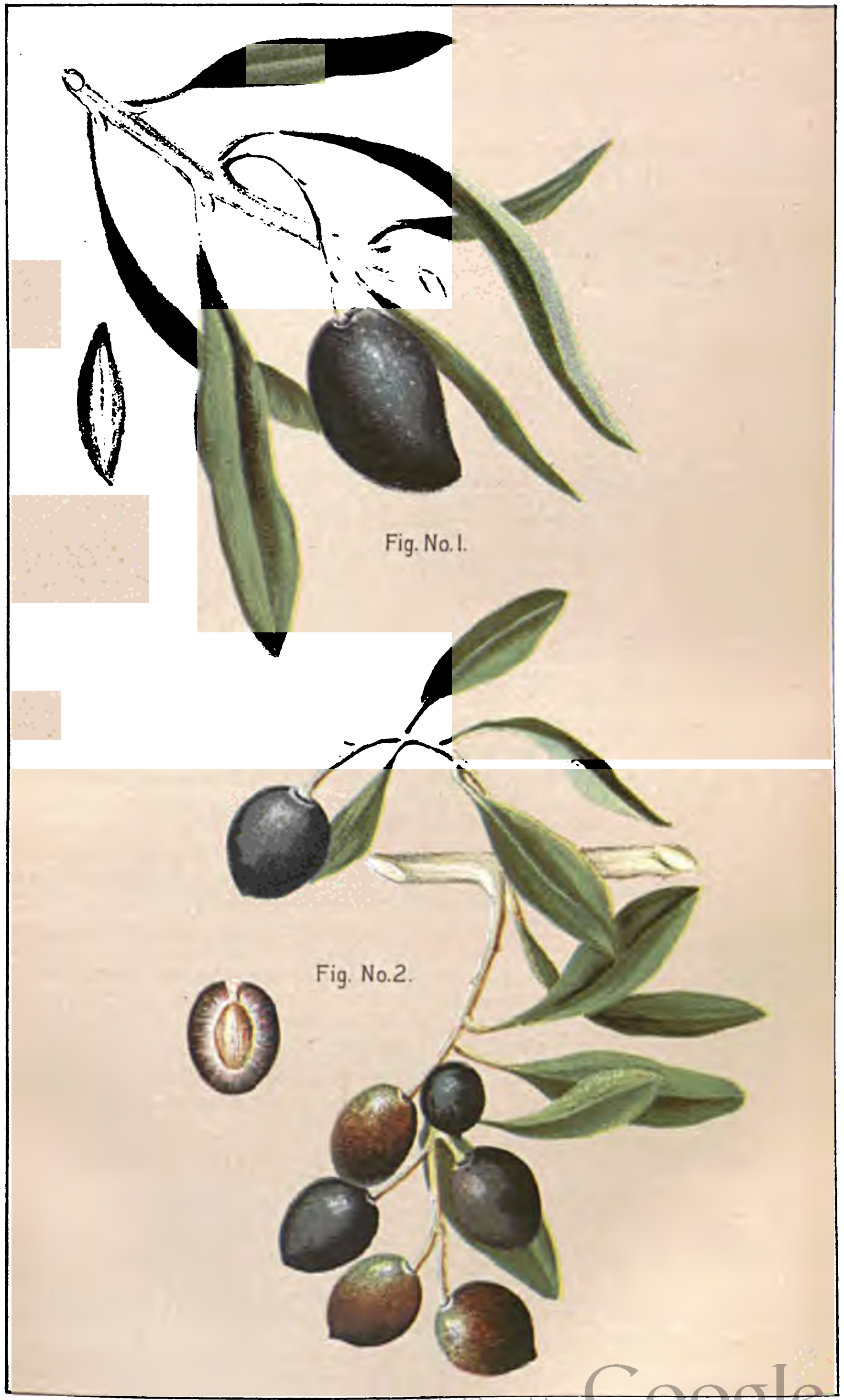


Fig. No. I.
Fig. No. 2.

Fig. No. I. PICHOLINE. Fig. No. 2. REDDING PICHOLINE (CAL.).

INTRODUCED VARIETIES.

PICHOLINE.

(*Plate I, Figure 1.*)

This tree is of vigorous growth, but of average dimensions; its trunk is cylindrical; its branches extend horizontally, and are of slight build; the rejection of its leaves are not numerous. The leaves are ovate-lanceolate, very often enlarging themselves at the superior part; of average length; average length about two and one half inches; width, one half to two thirds of an inch; top surface of a dark green color; bottom surface, approaching end of leaf, rather thick, and of a soiled white color. The leaves accumulate in great numbers on the young branches, covering them thickly. The fruit generally accumulates in the direction of the branches of the year (yearly branches), isolated or grouped by twos; the stalklet is very short. The fruit stalk is very large, but short, and inserting themselves in a rather large depression of the fruit; stigmate persistent, in an umbilic not very visible.

The fruit of the Picholine is very delicate; the tree yields a good and regular production; hardy, and cultivated more for the purpose of pickling than for oil making.

The olive is a trifle below the average size, of elongated form, but large near the fruit stalk, with a tendency of tapering itself towards the point; rather symmetrical; strongly fortified on one side at a point not attached; intermediate form between varieties *Oliviere* and *Lucques*. The fruit changes in color from light green to wine red, then to red black; the surface carries a number of spots sufficiently visible. The skin is fine and the pulp abundant, of a dark red color, and quite fleshy; the pit is small, very elongated, pointed at both extremities, with a more pronounced curvature than is generally found in most olives.

REDDING PICHOLINE (CAL.)

(*Plate I, Figure 2.*)

This tree is of small dimensions. The fruit is very small, as shown in the illustration, and is of deep blue-black color; it makes very good oil and a very sweet pickle (ripe and green), but is best suited as a stock to bud and graft upon. This little olive was introduced several years ago under the name of Picholine, which name it bore until it came into fruiting. I have seen some of the original trees that were imported at that time. There is more than one variety. The tops of the trees supposed to be the Picholine died down below the graft, and they put forth many shoots, from which this little olive originated. It is no doubt a wild species; it belongs to that type. The illustrations of this, as well as of the Picholine, are natural size, and if their characters be studied the difference between the cultivated and the wild type will be observed without much explanation. The leaf of the cultivated type is oval, lance-shaped, and enlarged at the superior part. The leaf of the wild type is short, broad at center, and a character too well known among that species. The pit of the cultivated species is of many types. The wild olive has only one, as shown in the illustration of the Redding Picholine (Cal.). The fruit of the Redding Picholine being so small, makes it difficult of gathering. In gathering the fruit the best process in use is to lay on the ground under the trees large cloths, and the fruit is then stripped from the limbs with a wooden hand comb; they are then passed through a blower, to separate all the leaves, etc., from the fruit.

COLUMELLA.

(*Plate II*, *Figure 3.*)

I consider this variety a most valuable acquisition, because of its productiveness and superior quality of its fruit.

The tree is a rapid grower, of medium dimensions, stocky, and well able to support the great weight of such heavy crops as this olive produces. This is a very productive variety, and the weight of the fruit generally brings the branches to the ground, unless they are propped. It grows in poor as well as in rich soil; in the former the berries never attain a high color, being rather pale, and the oil, while good, is never of the best. On the latter, the berries attain a high color, and the oil is of the finest quality. The berries attain a better size and produce the best grade of oil in soils suitable to olive culture. In low, damp soils this olive thrives, but the fruit grown under such conditions can only be utilized in the form of pickles. The fruits of the Columella are bright yellow before maturity, and on ripening change to wine red, then to red black. The fruit being bright yellow before maturity is most valuable for pickling. In the ripe state I have submitted it to a simple treatment of pure water, and in six days the fruit was ready for the table. It will thus be seen that the olive contains hardly any bitterness. The ripe olives contain a large percentage of oil. This olive is one of the hardy kinds and stands heavy frosts.

This is a medium early variety. In some localities the berries become ready for pickling in September, and for oil in October.

UVARIA.

(*Plate II*, *Figure 4.*)

This is a very valuable olive, both for pickles and oil. The tree is a rapid grower and quite hardy. It grows in poor and rich soils; its production is good on either, but better in soils and conditions suitable to the growth of the olive. The fruit is medium small, of a dark blue color, and hangs in clusters, resembling clusters of grapes. I have counted as many as fifteen large berries on clusters, as shown in the illustration. The fruit is excellent for pickles and for oil. I consider this variety one of the most valuable, and is perhaps the most productive olive that I know of. Last year the fruit on many trees was left on them until the heavy frosts in winter. All the other varieties near this one (except Columella) dropped their fruit. What fruit did remain on the trees shriveled and became worthless. The Uvaria did not shed any of its fruits, and the fruit was damaged but little. Many of the foreign varieties suffer greatly from cold weather; this is especially so with the early varieties; when the fruit is damaged by the frost, it rots on the tree. This variety is an early one, but the fruit can be left on the tree until late in winter, as it stands cold weather.

SAILLERN.

The Saillern is a very hardy tree, middling or tall, spreading out; trunk very big, enlarged at the base. Branches pretty vigorous, generally in limited quantities and large, much bulged out at the insertion, of dirty yellow color, longitudinally striated, and covered with apparent and pretty numerous freckles; wood decidedly canaliculate; knots not prominent. The leaf is lanceolate, regular, short, relatively large; upper face shining light green, a little wrinkled; under face covered with a dirty white coating, pretty abundant. The leaf is nearly flat, the edges but slightly drawn back; the cover of the tree is but little provided with leaves, on the inside it is always tolerably thin. The limbs are not very thick, flexible; nerves well delineated on upper face. The mucron is well marked on the wide point of the leaf; hard, short, bent round. The petiole is large, short, bent over, bringing the leaves upon one another on the same side of the branch. The fruits generally isolated, occasionally grouped in twos on two-year old branches. The peduncle is long (fruits hang down), inserted in a light depression of the fruit; stigma persistent in a well marked umbilic. The olive is quite small, nearly ovoid, a trifle oblong, slightly bulged out on one side. The fruit is deep black when ripe, and very hoary; skin thin; pulp not abundant nor fleshy, juicy, colored a deep vinous red. The pit is big, of same form as the olive; tree of middling maturity.

A delicate tree, sensitive to cold. It is, nevertheless, a meritorious variety, especially on account of the excellent quality of its oil; not grown for pickling.

ROUGET.

The Rouget is a hardy tree, erect, and a rapid grower under favorable circumstances; trunk cylindrical, canaliculate; bark blackish gray, wrinkled; the main limbs are either horizontal or upright; the form of a vase or a ball are the most favorable to its development; shoots very numerous.

The branches are numerous, even in the old wood; hardy, long, thin, horizontal, or semi-erect, of a dull gray, wrinkled, covered with many small regularly distributed freckles; wood irregularly furrowed, even on old branches; knots prominent. The leaf is lanceolate, pretty short, large; upper face deep green, with pretty numerous punctures stamped on the edges; under side slightly coated greenish white. The limbs are thick, with edges slightly drawn back; nerves little marked on both faces. The mucron is quite tender, little prominent, but well defined in the plane of the leaf. The petiole is short and quite thick. The leaves are numerous and the cover thick, of deep color; inserted perpendicularly on the branches, the leaves present outward their upper face; the result is that the tree is of a deep hue, and can be recognized at a distance. The fruit is generally distributed on the whole length of the two-year old branches, more numerous at the base; isolated or in groups of two, three, or four. The peduncle is quite long, entering into a shallow depression; stigma little apparent. The olive is of middle size or small, ovoid in form, narrowed in towards both ends; the fruit remains light red for a long time, then turns to a reddish black; some olives remain red till the general crop ripens, hence its characteristic name of Rouget. The fruit is speckled with pretty numerous dots well marked on the red or reddish background; not very hoary; fruit rather shiny; skin pretty thick; pulp fleshy, colored by an abundant vinous red juice. Pit middling or small, of elongated ovoid form; this is a very late variety.

The Rouget is a hardy variety, not sensitive to cold, and yields an oil of fair quality; also good for pickling.

VERDALE.

The Verdale is of dwarf habit, half erect, and has little vigor; trunk thin, short, conical, canaliculate, with bark rough and greenish gray; branches slightly drooping, principally those at the top of the tree; the tree has the general form of a ball with a light cover; the roots do not penetrate at a great depth, and the tree is frequently rooted out by strong winds. Shoots scarce; easily grafted. The branches are not numerous, upright, or slightly inclined, inserted at a right angle, of a dirty yellow or light yellowish gray color; freckles scarce and dim; knots pretty prominent. The leaves are linear, short, very narrow, well characterized by their feeble dimensions. The nerves are very prominent, of light green; edges drawn back and forming a regular, well marked channel. The mucron is not detached and is but little prominent, slightly acute, situated in the plane of the leaf, slightly inclined in the direction of its curvature; upper face dull light green, a little wrinkled; under face dull white; limbs of medium thickness. The petiole is short, thin, bent round, so as to bring the upper faces of opposite leaves together; all the leaves are situated in the same plane on the branch, and frequently form with the latter a very acute angle.

The leaves are pretty numerous at the ends of the branches, scarce elsewhere; cover of the tree light. The fruits are generally isolated, never together in great numbers, with peduncle of middling length, thin, dirty green, inserted into a hollow depression, big, nearly round, slightly truncated at the top; very green till nearly ripe, then of a vinous red, and finally of a deep black, somewhat dull; very hoary at maturity; olive soft, with rather thick skin; pulp fleshy and little juicy; pit very large, of same form as the olive, with surface but slightly furrowed; very early.

This is a very early variety, but little productive of oil; rots quickly when fully ripe; much cultivated for pickling, but must be set out only in good soil, or in ground of medium quality, as its production is a failure in poor soil. It is quite sensitive to cold, and the dropping of the fruit frequently diminishes the crop.

OLIVIERE.

The Oliviere is a hardy tree, never of a very large size, but spreads out; trunk cylindrical; bark, blackish gray, full of fissures about the trunk and heavier limbs; the heavy limbs are either horizontal or inclined downward, their many branches falling to the ground; the whole tree looks like a cylinder much broader than high; has usually but few shoots.

The young branches are vigorous, bent round, spirally arranged, and grow out at an acute angle; they change from a clear ashy gray to a blackish gray after the first year; the wood, quite quadrangular at the outset, becomes cylindrical as the branches grow older; besprinkled with light brown freckles. The leaves are oblong, oval, lanceolate, large to very large; upper face of shining green, thick, even white coating on lower face; limbs, thick, with edges much drawn back, forming a channel; nerves appearing only on upper face. The mucron is long, acute, bent round toward the under face of the leaf. The petiole is middling, inserted at a very acute angle, especially at the end of the branches where the leaves are habitually accumulating. The leaves are very numerous, and the cover of the tree thick; they are, besides, drawn up, presenting out their under surface, so that when seen at a distance the tree has a very peculiar whitish appearance. The fruits form at the base of two-year old branches; seldom on dressed branches; often in groups of twos and threes. The peduncle is long, of middling thickness, entering the fruit in a rather deep depression; stigma little apparent at the point of the fruit. The olive is of medium size, flattened out at the insertion; of cylindro-conical shape, but slightly bulged on one side; little elongated and ending abruptly by a prominent and well delineated point. The fruit changes from green to red, and finally becomes, at maturity, of a bluish-black color, with a few spots of dark red; it is dimly dotted, hard when ripe, and not abundant juice. The pit is pretty large, of the general form of the olive, with wrinkled surface, and a very sharp point; tree of second maturity.

The Oliviere is a very hardy tree, and withstands without much injury, the most severe frosts; it grows to perfection only in rich soils.

LUCQUES.

The tree is of middling vigor and development; semi-erect, cylindrical trunk; the bark comes off easily in long strips, so that the trunk is often almost entirely laid bare; the main limbs are either horizontal or erect; as a whole, the tree habitually takes the shape of a vase, a ball, or sometimes of an umbrella, according to the mode of trimming; shoots scarce; branches hardy, long, straight, erect, or horizontal; young branches pretty numerous, situated upon the limbs at a right angle, generally drooping, of a decided gray color, longitudinally striated, and covered with a great number of freckles; wood of hexagon form, especially at the end of young branches; prominent knots. The leaf is sublinear, lanceolate, pretty long, but narrow; upper face light green, dull, somewhat wrinkled; under face covered with dirty white thin coating; limbs not very thick; nerves little marked, even on upper face. The mucron is acute, short, bent round in the plane of the leaf. The petiole is long, thin, and bent round. The leaf is drawn back at the edges; it is unequilateral, and assumes the shape of a very much elongated crescent, ending by the mucron. The cover of the tree is pretty light, owing to the limited number of leaves, their relative smallness, and the divergent disposition of the branches. The fruits are often isolated, distributed for the most part at the base of the young branches. The peduncle is long, thin, entering into a shallow depression of the fruit. The olive is pretty big, of the form of a crescent or keel, having both ends bent round, and the opposite side of the curvature nearly rectilinear, which makes it of a very peculiar shape. The fruit changes from a light green to shining bluish black; very little hoary; the surface is slightly speckled; thin skin; abundant pulp; pit pretty big, of similar form as that of the fruit, bent round at both ends, with furrowed surface, ending by two points, the lower being the sharper. Fruit ripens early.

The Lucques is a tolerably vigorous tree of medium longevity. All writers who have studied this variety consider it as very enduring in cold weather, and adapted for cultivation on the extreme boundaries of the olive tree region. The production of the Lucques is relatively small, but this cause of inferiority is partly compensated by the beauty and excellent quality of the olives gathered green for pickling purposes. It is the most highly prized and best table olive, and it always commands the highest price in the market when gathered at the right time. The oil furnished by the Lucques is of very good quality.

PIGALE.

The Pigale is a tall tree, semi-erect, and hardy, canaliculate trunk; bark grayish, knotty. The main limbs are most always upright or semi-erect, seldom horizontal. It is one of tallest olive trees when allowed to grow without heavy amputations. The branches are very numerous, hardy, big, smooth, of dirty gray color, much swollen at their insertions, which is at an acute angle; wood slightly channeled on young branches, with small freckles, not numerous, and irregularly scattered; knots but little prominent. The branches are but slightly drooping in general; leaf lanceolate, rather short, a little drawn in towards the insertion; upper face deep green, smooth, riddled with small white punctures, very well marked (peculiar); under face greenish white; limbs thick and a little coriaceous, with edges slightly drawn back, so that the leaf has pretty much the appearance of a wide and shallow channel; nerves a little prominent on the under face only. The petiole is big, short, straight, growing out of the branch at almost a right angle. The leaves are regularly distributed on the young branches, and almost perpendicular to the latter; they are numerous enough, but owing to the tree spreading out pretty much as a rule, the cover of the tree is not very thick. The fruits are regularly distributed on the whole length of the branch, isolated or grouped. The peduncle is quite long, large, light yellow, inserted into a deep depression. The olive is rather large, cylindrical, regular, oblong, rounded off at both ends; red at first, the fruit finally becomes a deep black; hoary to a small degree, and, but for a short time, gets very shiny; upon the shiny background numerous white dots appear well defined. This olive remains firm until ripe; skin thick; pulp fleshy, little juicy, colored white or light vinous red. The pit is big, of regular shape as the olive itself. A late variety.

The Pigale is a commendable variety. Granting that its production is somewhat curtailed by its luxuriant growth of wood, the fruits are of good quality, and fit for table use, as well as giving a great deal of oil of excellent quality. As this olive ripens very late it cannot be gathered only late in winter, when often its surface gets wrinkled on account of the frost.

MANZANILLO.

The fruits of the Manzanillo are quite large and of irregular orange shape. The color of the fruit is deep blue-black, and has on its surface very minute white specks; it is a freestone and for this reason is so highly prized for pickling. The pit of this olive is different from any other olive. I have seen it very short and smooth and of a peculiar shape, as the olive itself.

This is an early variety, ripening in October. The oil from this olive is of very high grade. The tree is a rapid grower and a prolific bearer.

RUBRA.

This is a remarkable variety; fruit medium size, bears heavy and regular crops. This olive is best suited for oil, but is also used for pickling. It is one of the sweetest olives, and a freestone. The oil from this olive is of the highest grade. The tree is a very rapid grower, more so than most varieties. This olive does well in most all kinds of soil, but should not be planted in soils not suitable to olive culture. In low, damp soil, the fruit never attains its natural color, and such fruits never make good oil. I have seen this olive growing in dry, hilly soils, almost unfit for the growth of any tree, yet this tree is growing there and producing a medium annual crop. I made oil from the fruit this year and it is of very fine quality. The tree begins to fruit when quite young.

MACROCARPA.

This tree is of a dwarf habit, a bush. The fruits are quite large; of light purple color, changing to red black when mature, and accumulate on the branches singly, and in twos, in opposite directions.

This is an early variety; ripens in October. The fruit can only be used for pickles, as they contain but very little oil, which is not of good quality. The fruit is very easily damaged by cold weather, and should be picked as early as possible, as a cold snap rots the fruit on the tree. It should never be set out in low, damp ground, as the fruits will never become of any size under such conditions. They rot even when green. On land suitable to the growth of the tender kinds this variety grows and fruits to perfection.

PENDOULIER.

This tree is a beautiful one, of a vigorous growth, and of large dimensions; branches drooping (weeping) in character; color of wood light green, with smooth, clear surface; it is a tree of very good production. The fruits are large, generally accumulating singly in opposite directions, also by twos on the fruit stem; length, one and one eighth inches; width, three fourths of an inch; color, wine red, changing to deep blue-black; has on the surface a number of very small white specks, which are quite visible, but very minute. The pit is about three quarters of an inch long, tapering at the upper end, broad at center, with a curve commencing about the center down to the point.

This is a valuable olive for oil and for pickles.

PENDULINA.

This is a handsome tree and a very good bearer; fruit medium to large, ripens early. The fruit of this olive produces a fine grade of oil. The fruit is also used for pickling in the ripe and green state. It ripens in October.

ATRO-VIALACEA.

This tree is a vigorous grower, of a weeping habit, and of very good production. The fruit is medium to large, of a deep blue-black color; the flesh is marked with vinous red. The oil from this variety is of high grade. The fruit is also suitable for pickles in the ripe and green state.

MISSION.

This tree is of good production, and of very large dimensions; fruit varies in form; several types have been observed on trees; this is somewhat peculiar, as among other varieties this does not occur. The fruit hangs on the branches singly, in twos, threes, and also in clusters; color deep purple, changing to jet black. It carries on its surface numerous white specks, but gradually they nearly disappear upon ripening; a freestone; ripens late.

The Mission is a tree of great longevity. At the various Missions throughout the State may be seen many trees over a hundred years old, in the prime of health and still fruiting. It is a tree that has done exceedingly well, and much better where properly cared for. It can be found growing and fruiting in almost every county in the State.

XII.

GRAFTING AND BUDDING.

The olive is grafted and budded during the spring of the year and through the summer very successfully. The purpose and action of the graft and bud are:

(*a*) To multiply the varieties selected on trees already constituted, or on vigorous subjects.

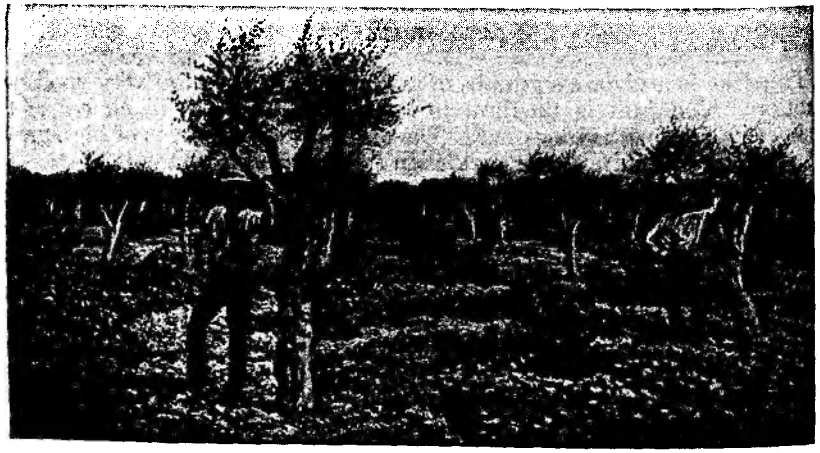
(*b*) To further the wild or semi-wild stocks.

(*c*) To excite the development of the branches, blossoms, and fruits on the parts of the plant lacking them.

(*d*) To reinvigorate ailing olive trees by grafting them at their root; to regenerate those not very prolific, by grafting them with others of greater fertility, and to make others more resistant to the frosts by grafting them with hardier varieties.

Besides, grafting exercises an influence in several ways: On the stature and durability of the object; on its fruitfulness; on the size and flavor of its fruits, and on the precocity of fructification.* Grafting also modifies the development and sometimes also the duration of the object, making it larger or smaller, long or short lived according to the vigor and the stature of the subject. Here are some proofs that have been collected: The olive tree becomes larger and long lived when grafted on the wild olive tree, instead of being produced from cuttings, ovules, or suckers. The success of the operation is more certain when it is performed in spring, on the awakening of the vegetative functions; that is, when the bud is unfolding, rather than at the end of summer, when these functions are on the decline (when the bud is dormant); otherwise the subject and the object may suffer from the cold weather of winter.

CLEFT-GRAFTING.



Olive trees grafted in March, showing the growth made in six months. (View taken in September.)

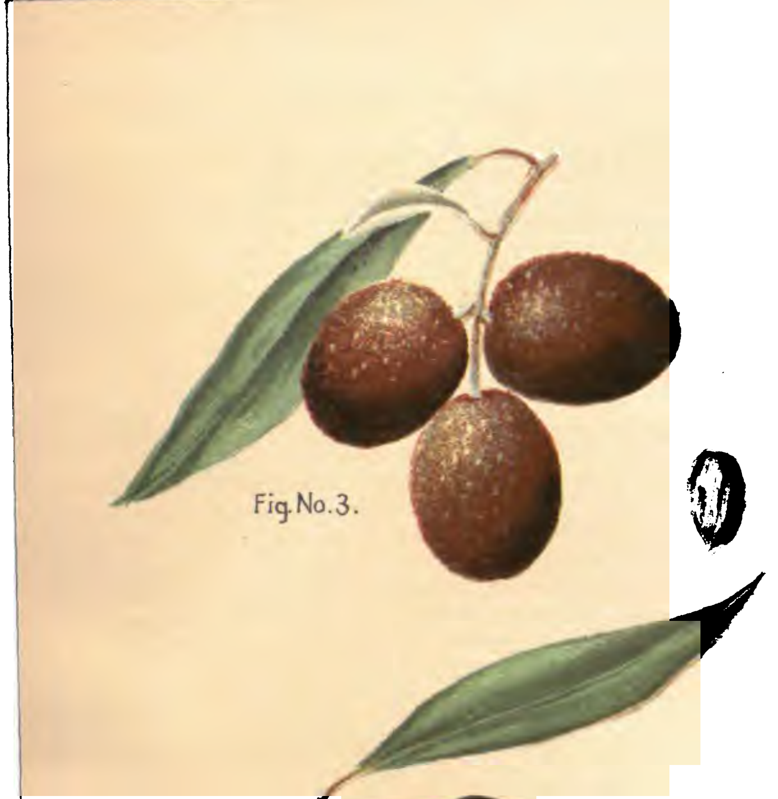
It is performed in March and April.

Cleft-grafting is made with one or two shoots. If the subject is of an average size, but not less than seven eighths of an inch in diameter, one graft

---

* Annals of Sicilian Agriculture, second series, Palermo.

THE OLIVE. Plate II.



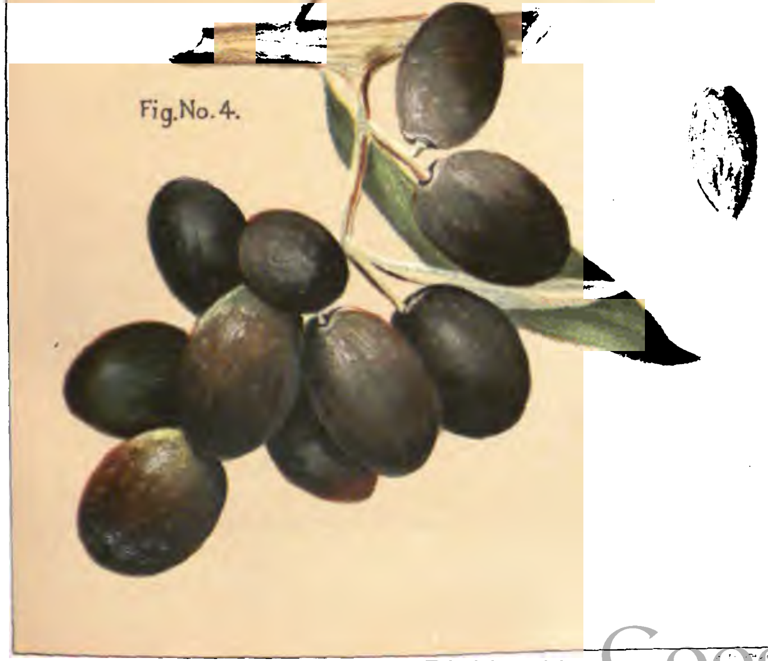


Fig. No. 3. COLUMELLA. Fig. No. 4. UVARIA.

is sufficient, and the area of amputation must be slightly inclined. For larger subjects more scions are wanted, and the area is made horizontal.

The younger the subject the shorter should be the scion.

In a fresh, rich soil and humid climate, let the grafts have four or five buds; in a poor soil, with a dry and warm climate, short and strong grafts are suitable; in a middling soil, two or three eyes on an object three and one fourth to four inches long are sufficient.

The subject is prepared by cutting it at its lower part in the form of a nearly triangular wedge, sloped in such a way as to gradually reduce the faces to a sharp angle at the extremity, leaving a strip of bark, which increases in width up to the base of the wedge. Opposite the angle is the back of the wedge, beginning under a bud and terminating in a point at the lower extremity of the scion. This point must be slightly smoothed to facilitate the sliding of the subject in the cleft.

The subjects of medium size are cut off obliquely and the cut smoothed; then, with a firm and steady hand, a vertical cleft is made with the point of a knife, the slit being nearly one third less in length than that of the wedge or of the scion. The skill of the operator consists in not splitting the subject from side to side. The object is next inserted from the top, the cleft being extended with the knife until the wedge of the scion is wholly inserted. After binding, and spreading the grafting wax, the operation is completed.

An olive tree grafted March twenty-fourth, showing the growth of the graft made in a little over a month. (View taken in May.)

When the subjects are rather large they are cut horizontally and split from side to side to insert the scions; then the ligature is made and the grafting wax spread. The cleft throughout the whole diameter of the subject is made with an iron wedge or chisel, driven in by hand or with a wooden mallet. When the cleft is two thirds open, the chisel is leaned against one side to keep the slit half closed and open it sufficiently to insert the scions one after the other.

The illustrations show the success attained in grafting the olive, performed by the above method at the Quito Olive Farm, San José.

CLEFT GRAFT, FOR SMALL STOCKS.

This method is similar to the one used by orchardists, only that the cut in the stock is not made in the center, as in the former. The cut is made from either side, as shown in Figures 17 and 18. The graft is cut from both sides, as in the ordinary way, to be large at the surface side and thin at the inner; then it is inserted into the stock, as shown in Figure 17. The graft is driven down as far as it will go, and is made to fit exactly (both barks to be even) on the surface side; the other side does not matter, as the unit of the graft and stock is on the surface side. In time both sides heal over. After the graft is inserted it must be tied and waxed, and if the operation is performed in the field, it must be covered up with earth, leaving as little of the graft exposed as possible. The entire leaves on the

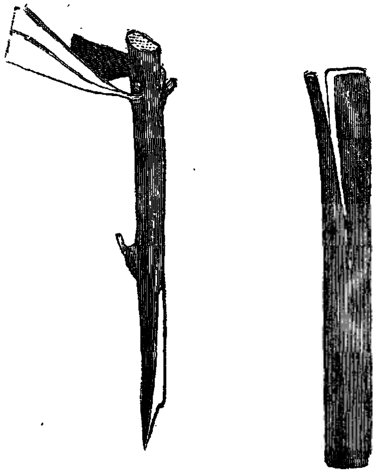


Figure 17.

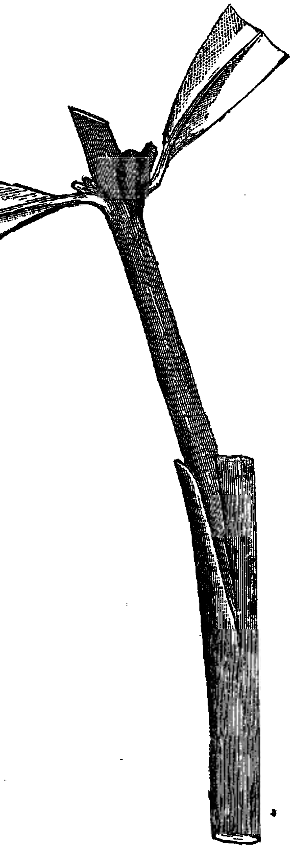


Figure 18.

grafts must not be cut off, at least one third of the leaf must be left (as shown in Figure 18), to prevent the graft from drying before it has had time to unite with the stock; also, the entire leaf must not be allowed to remain on the graft; the trimming of the leaf prevents it from carrying off too rapidly the fluids of evaporation. In this method one point must be observed, and that is the manner in which the cut in the stock is to be made. If due precautions are not taken, and the cut be made in the center of the stock, the stock will crack at the time the graft is inserted, and a perfect fit cannot be had. The more the graft is pushed down into the stock, the more the stock will crack below the point of the graft; this results in the loss of the entire tree.

The best time to graft the olive is when the trees commence to put forth new growth, through the summer months.

CROWN-GRAFTING.

Crown-grafting is practiced, according to locality, during March and April, when the plant is in sap, and the bark can be easily detached; but the subject must be cleanly cut off with the shears or the saw thirty days before, and when the time of grafting has come, the wounds are revived with the pruning knife or hook and the dry portion taken off. This mode of grafting is suitable for middling and large trees, for the latter it is even necessary, because it permits to insert several objects, in proportion to the vigor of the subject itself.

Let the graft or object be of about two to four inches. Let the higher portion have two or three buds, and cut the lower end like a flattened wedge or obliquely. The wedge must begin in front of a bud, starting from the medullar sheath and ending by continually thinning in an acute form. Being thus deprived of the pith, it adheres better to the subject; it must have, therefore, but little thickness. A small notch in the upper part of the wedge will permit to place more securely the object on the subject.

The insertion is made on top of the subject, in a cut between the bark and the wood. To facilitate the entering of the wedge, its point is either sharpened or moistened when inserted into the subject.

Before inserting the object, a small wooden or ivory spatula, with a slender point, is introduced into the slit. Then it is withdrawn and in its place the graft is inserted; in this manner the delicate branches are not broken nor is the bark lacerated.

To introduce the object take it by the top and slide it between the bark and the sap wood, pressing it gently until the transverse upper cut of the wedge fits well the cut of the subject. If the graft is of such a size as to break the bark, make a short incision into the latter from above downwards.

When several objects are to be inserted into large stems or branches, they must be placed a good distance apart.

The insertion being made, the parts are bound lightly, so that the bark may not be too compressed. Then the grafting wax is spread on the wounds, on the cuts, and on the bark corresponding with the inserted wedges, so as to prevent lacerations. The adhesion of the grafting wax is facilitated by drying with a sponge the sap that has flowed from the cuts.

By making the crown-grafting as much as possible near the ground, both the subject and the object can be covered with earth as far as the higher buds; in this manner the success is more certain, and the development more prompt, thus the drying up of the parts is prevented and the development of roots from the incisions facilitated.

Generally, the objects are taken from branches one year old, but for the olive tree two-year old branches may also be employed. In the latter kind of grafts the wedge is cut off the old wood, according to the described method, and inserted into the subject after making an incision into the bark and enlarging the opening with a thin spatula or a slender wooden wedge.

When only one graft is to be inserted into the plant, the success of the grafting is more certain if the subject be cut off obliquely and the corresponding end of the object hewed to a wedge, beginning by a small tongue at an acute angle. This tongue is necessary to make an exact joint with the oblique surface of the subject.

The vertical incision of the subject being made, one of the lips is raised with the spatula and the wedge introduced in such a manner that its interior face is laid over the sapwood and its back covered by the lip. A cuneal piece of bark is then taken off the outer angle of the wedge so as to make it adhere closely to the other lip. This ends the operation, and there remains only the binding and waxing.

EYE-GRAFTING.

Shield and *ring*-grafting are two methods followed in grafting the olive. The first is generally preferred, save in a very few cases when ring-grafting is adopted.

Shield-grafting can be practiced from April and May to September. If made in summer, the shield is taken from a medium sized branch of the year's growth; if made in the spring, from a branch of the preceding year. The buds must be well formed and unexpanded, and the branch in sap so that the bark may be removed with the nail.

The maturation of the object-bearing branch is recognized by the dark color of the epidermis, by the formation of the terminal bud, by the elasticity of the tissues under the pressure of the fingers.

A branch advanced in maturation is preferable to one still herbaceous; the early or too forward branches, and those too floriferous, are bad object-bearers.

The eyes situated in the middle of the branch are to be preferred for grafts; those near the basis and on the top are often defective, because they are either tender or herbaceous, or too disposed to bear fruits.

In regard to the subject it must be in sap to receive the scion, consequently the bark must be easily removable.

The branches of the subject that impede the operation must be removed some time before, in order that the course of the humors may not be abruptly arrested at the moment of grafting and the success hazarded.

PREPARATION AND INSERTION OF THE SHIELD.

To extract the shield from the branch two transversal incisions are made with the grafting knife above and under the bud to be removed, one from one half to three fourths of an inch above the bud, the other about the same lower. The blade is inserted as far as the sapwood (alburnum), and the shield extracted with a ligneous fragment, in which is the basis of the bud. The alburnum adhering to the extremities of the shield may be skillfully removed if the subject is not much in sap. The shield can also be extracted by making three incisions into the bark of the branch in the form of a triangle, that is, one transversally over the bud and two in form of V, starting from and terminating under it in an acute angle.

Before detaching the shield, two incisions in form of a T are made into the bark of the subject, dilating the borders of the wound with the grafting knife; then, holding it by the pedicel, the shield is detached and with the aid of the knife inserted through the slits, pressing it quickly with the fingers at the same time, so that it will fit exactly the alburnum of the subject and be covered with its bark, the bud excepted. This being done, the ligature is made from up down, in order to prevent the displacing of the shield.

There are cases when the sap of the subject is abundant and injures the graft. This may be prevented by making the incision into the subject in form of ⊥ instead of T. The shield is cut square at the lower end and pointed at the top, leaving the bud, however, in its natural position. The shield having been inserted through the transverse cut of the incision in ⊥, that is to say, from down up, the ligature is made from the lower part of the wound upward, in order that the shield may not be displaced from its position.

RING-GRAFTING.

There are two modes of performing this grafting on the olive tree: with cortical ribbons folded on the object, or without ribbons. Both require stems or branches of a small diameter, and well in sap, and allow the head of the subject to be cut off after the operation has turned out well; that is, when the object has taken well; this permits, also, to repeat the grafting in case it has not succeeded.

The mode of proceeding is as follows: The object for simple ring-grafting must have one or more buds, and be at least two and one fourth inches in length. Having made a vertical incision into it with the grafting knife, the object is carefully detached with the knife from the underlying alburnum, and stuck into the subject, which has been bared of an equal tube of bark. In making the insertion care must be taken that the bud of the graft be close below a bud of the subject, in order that the latter may draw the sap towards the object, thus insuring its development. Should the object be of greater diameter than the subject, it must be reduced in size accordingly; if, on the contrary, a portion of the subject remains uncovered after the application of the graft, a piece of bark must be added to fill the empty space. Lastly, the ligature is made.

In ring-grafting, with cortical ribbons, the object is prepared as in the preceding case, but the bark of the subject is cut into ribbons folded downward. The ring being applied, the cortical ribbons are drawn up over it, and the whole kept in place by a proper ligature.

INDOOR GRAFTING.

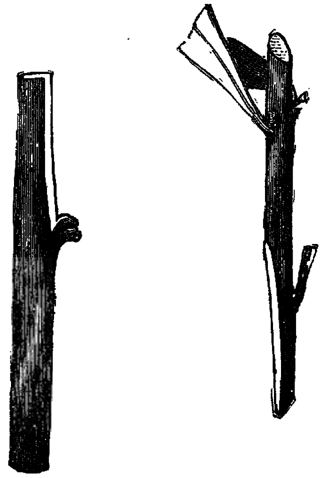


Figure 19.

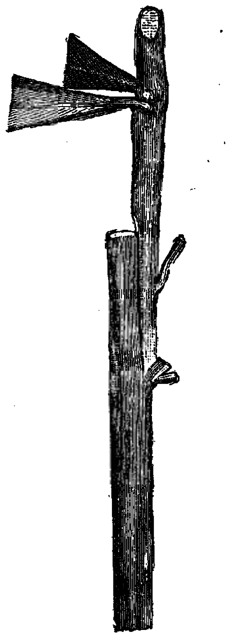


Figure 20.

This method, as illustrated in Figures 19 and 20, is practiced mostly indoor, in the greenhouse, or under frames. The stock is not entirely cut off, as shown in the illustration, but about one half of the foliage is removed. The operation is performed by cutting into the stock, simply pressing the knife slightly, so that when the cut above is made it will form at the lower part a cut in the shape of a V. This cut is made right and directly over a bud (a leaf) on the stock; this has the tendency of drawing to the graft nutritious sap, which keeps it alive, and aids it in uniting with the stock. The graft is then trimmed, leaving to it about one third of the leaves, as shown in the illustration, and inserted as shown in Figure 20. Care should be taken that both barks fit exactly on one side, while the other side does not matter, as it heals over in time. The graft may be waxed, if the operator so desires, but it is immaterial, unless under low heat or no heat at all. After the graft has started, the stock above the bud is cut back, when they may be removed to the open air or planted in nursery.

TWIG BUDDING (ORIGINAL).

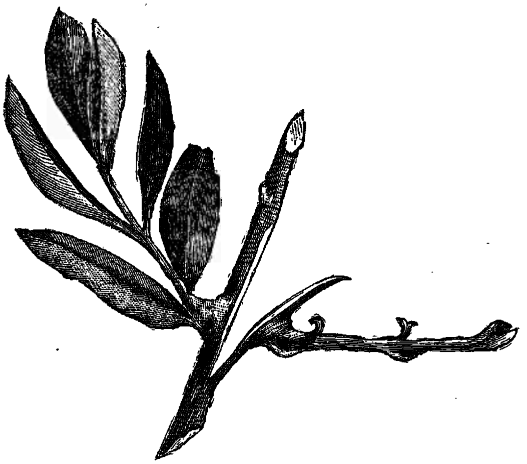


Figure 21.

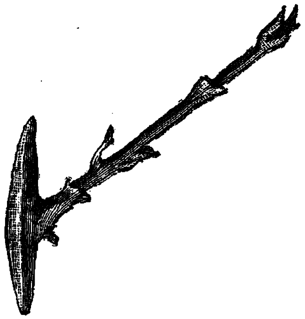


Figure 22.

This is a very simple method of budding the olive, but can only be performed when the sap flows very freely, during early spring and summer. The bud is cut as shown in illustration (Figure 21), which is the scion; the cut is made deep into the wood in order to give the bud as much bark as possible. The leaves are partly cut off, leaving at least a half inch of the leaf on the twig, to prevent the bud from drying; then with the sharp point of the budding knife, the greater part of the wood inside of the bud is removed, as shown in Figure 23. If part of the wood is not removed, the bud cannot take, as the wood in it prevents the two barks (the inner bark of the bud, and the inner bark of the stock) from uniting. When the wood has been partly removed from the bud, the bud is inserted into the stock, as budding is done in the regular ordinary way, and tied tight. At the end of three weeks the string is removed, and part of the top of the stock is cut back to force the bud to start. As the bud grows the foliage of the stock is gradually removed, until the bud is able to take up the entire flow of sap; it is then left to grow, and trained to the stock. When the bud has grown and become stocky, what remains of the stock above the bud is cut smooth, close to the bud, to allow it to heal over. This process is performed at any time of the year when the sap flows freely. If done late in the summer the buds must be left to lie dormant through the winter. Best results are obtained when the buds are inserted early in the spring of the year, as the operation can be performed to a much better advantage, and the buds will grow to some height before the winter months set in. When inserted in large orchard trees, or in limbs of large trees, they are left to grow until they have attained such a size as will justify in the removal of the entire top.

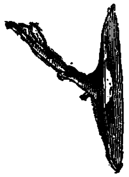


Figure 23.

EYE BUDDING.

The method of eye budding has been practiced with very good success. It is a very simple method, and can be performed by any person having a little knowledge in the use of the budding knife. In this method the bud is removed (every leaf is a bud) as shown in the illustration, Figure 25½. The leaf is cut off close to the bud, then the bud is removed, as shown in the illustration (the buds do not grow where the bud is removed, as shown in Figure 25½; this is only intended to show how the buds are removed from the scion), and a similar cut is made in the stock. The lower part is not cut, but the flap (or bark) is turned down, and the bud inserted, as shown in Figures 24 and 25. It does not matter if the buds do not fit (the bud should always be a little smaller than the space in which it is inserted). This being done, the flap (or bark) is turned up, covering the bud entirely; then it is tied tight with heavy twine. The twine for this purpose should not be less than eighteen-ply. The success of the operation lies in the tying. If it should not be tied tight the bud will surely die. The best way is to throw the twine in water, and use it while wet. After the bud has been inserted two weeks, the string is removed, and a week or so after that the tree is girdled above the bud, to force it to start. This girdling consists of a ring of bark being removed from the stock, being cut an inch or so above the bud. Care should be taken not to injure (by scraping) the wood after the ring is removed, as this would kill the inner bark, and cause the tree to die back before the bud has had a chance to start. After the bud has started it is trained to the stock, and left to grow until large enough to justify the removing of the entire top, and allow the bud to become the tree.

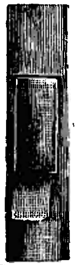


Figure 24.

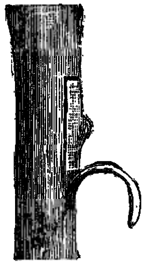


Figure 25.

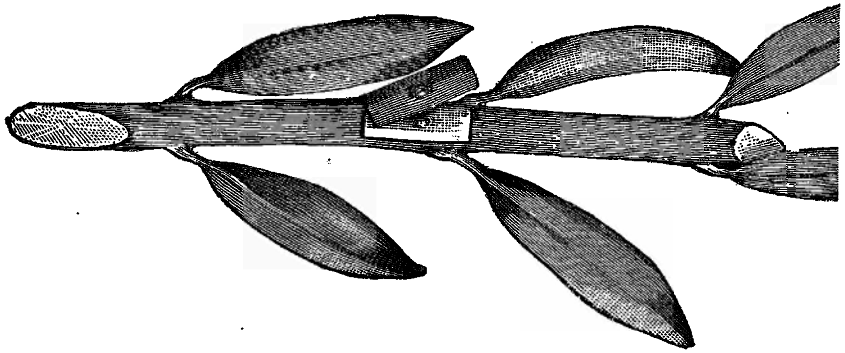


Figure 25½.

AN IMPROVED METHOD.

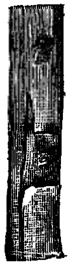


Figure 26.

In budding it was discovered that by making a cut in the stock in the shape of an H and raising the bark from the center crosscut (up and down) and the bud inserted, as shown in Figure 26, that both ends of the bud became protected, while in the other method only one.

This is an improvement, as it also has the advantage that large buds having a large bulge at the leaf part can be used, while they cannot in the method previously described.

The above described methods of budding and grafting are very simple, and can be performed by any untrained hand.

GENERAL CONDITIONS OF SUCCESS.

Whatever may be the method followed, several conditions contribute to the success of the graft, viz.:

First—The subject must be strong, because if feeble, the future tree will be of poor development, although the object may heal over.

Second—The object must be healthy, and the plant from which it is taken strong, because it is better to prevent than cure the evils caused by weakness or degeneration.

Third—The olive branches which are to be grafted in spring time, that is the object-bearing branches, called *scions*, or *shoots*, or *grafts*, must be taken off the parent during winter, when the weather is dry and mild, before the awakening of vegetation. Then, with their foliage entire or half cut off, they are buried in fine sand in a cellar or in a fresh and shady place, in order that they may not bud and the bark be kept alive without drying or rotting. The day before the grafting they are enveloped in green weeds, moss, or wet rags, and when the moment of transporting them to the place of operation arrives, their cut end is driven into humid moss,* or wet rags, or moist lumps of clayey earth.

Fourth—The two grafted parts must be in intimate contact with the respective cambium and regenerative zones, where is the *meristema*, that is the poliferous tissue; and in budding, the *procabium* of the subject must be well fitted with the gems of the object.

Fifth—The operation will be more successful if performed on a clear and calm day, more so than in rainy or cold weather.

Sixth—The parts must be tied up and well joined to prevent the enlargement of the cut portions.

Seventh—After the binding has been completed, all the wounds, especially when scions are used, must be protected from contact with external agents by waxing over with grafting wax, which will not permit the passage of air, and can resist the action of the sun, frosts, and rains.

---

* Many are the species of mosses and boraginaceous plants; some grow in the woods, in shady and fresh places; some on the walls and on the trunks of trees.

XIII.

OLIVE OIL.

ANALYSES AND METHODS OF DETECTING ADULTERANTS.

According to Konig, the elementary composition of olive oil is: carbon 76.67 per cent, hydrogen 11.95 per cent, and oxygen 11.38. By saponifying with lead oxide, Konig obtained 2.01 per cent of glycerine and 50.92 per cent of oleic acids; he returns the rest as palmitic and stearic acids. Van der Becke found, when he saponified with lead oxide, 3.76 per cent of glycerine, but, saponified with alcohol potash, 6.41 per cent of glycerine.

Adulteration of Olive Oil.—The number of processes which have been proposed for the detection of adulteration of oils in general, and olive oil in particular, is embarrassing, and the results in general are disappointing, all, without exception, only detecting with certainty comparatively large admixtures. However, the interesting observation made by Van der Becke, that when various fats are saponified by lead oxide, lime, and potash very different amounts of glycerine are obtained, has led to the invention of quantitative processes, enabling the analyst to detect, with certainty, foreign admixtures. Thus, Van der Becke saponified the following fats, and obtained percentages of glycerine as follows:

	Lead Oxide.	Lime.	Potash.
Cocoa butter	.23	2.19	5.99
Tallow	.13	2.43	7.84
Butter	7.93	7.99	10.59
Lard	6.60	8.27	9.27
Olive oil	3.76	----------	6.41
Rapeseed oil	4.20	----------	4.58
Linseed oil	4.40	----------	6.20

It is to be hoped that further work will be done in this direction.

The processes now used for the detection of adulteration in olive oil may be divided into physical and chemical:

Physical.—The spectrum of olive oil shows an absorption of the blue and violet rays, a fine line in the green, and a distinct deep band in the red. B. Nickels has proposed to use these facts in order to detect the admixture of cotton-seed oil, which gives no bands, and on comparing a definite measured stratum of the suspected oil with the same thickness of genuine oil, by the difference in the intensity of the absorption adulteration will be indicated.

Rousseau's Diagometre.—According to Rousseau, olive oil conducts electricity six hundred and seventy-five times better than other vegetable oil, and he has arranged a most ingenious galvanic apparatus for the purpose of detecting the adulteration of the oil by this means. The apparatus essentially consists of a galvanometer connected with a dry pile; the needle works on a delicate pivot fixed in a resin plate, and there is a circle divided into degrees marking the amount of deviation. The oil to be tested is placed in a small cup, and the current transmitted. The better the oil conducts electricity, the greater the deviation of the needle from the zero point, at which it is applied to a metallic upright connected with the oil by a wire.

Cohesion Figures.—A genuine sample of the oil must be at hand, and drops of this and of the oil to be tested must be allowed to fall from the same height, and, in a word, under exactly similar conditions, on to the still surface of water side by side, when a good judgment may be formed from the pattern of the film, and its similarity or dissimilarity to that of pure oil.

Specific Gravity.—The specific gravity is best taken in the ordinary way by a specific gravity bottle at 15 degrees. The following table shows the density of olive oil and that of a few of the oils, such as poppy and cotton-seed, which are often used for the purpose of adulteration:

Specific Gravity Taken at 15 Degrees.

Olive oil	.9176
Poppy oil	.9243
Cotton-seed oil	.9310
Sweet almond oil	.9180
Arachis oil (from the Arachis hypojea)	.9170
Colza oil	.9136
Sesame oil	.9230
Nut oil (Juglans regia)	.9260
Beech-nut oil	.9225

It is evident that the specific gravity will only be a conclusive proof when the adulterant has a gravity much higher or lower than that of the olive oil. With mixtures of an oil like, for example, arachis oil, of similar density, a determination of the gravity will not of itself throw any light upon the purity of the sample. Nevertheless, a determination of specific gravity should be always made as a matter of course, since it may confirm other tests, and in every case a knowledge of the density is important.

Chemical Tests—Oxidation.—The so called "elaidin" test, in which the oil is treated with nitric acid and copper turnings, and thus by oxidation transformed into a solid mass, is not of very much value as a test for purity, though possibly, by acting on a known pure sample, and examining it side by side with the suspected oil, valuable information may be obtained. The old fashioned nitric acid test, according to Mr. Michael Couroy, applied as follows, is of some service: *One part of strong nitric acid is mixed with nine parts of the oil, and warmed until the action is fairly set up; the flame is then removed, and the mixture stirred with a glass rod until the oxidation is over.* Pure olive oil thus treated sets into a pale straw-colored, hard mass in an hour or two, while cotton and other seed oils assume a deep orange red color, and do not set like olive oil. He asserts that there is a regular gradation of color, according to the percentage of adulteration, and that by imitation mixtures approximate quantitative results may be obtained. The amount of delicacy under the most favorable circumstances does not appear to be more than 5 per cent.

A similar oxidation test is that of saturating *sulphuric acid* with *hyponitric acid*, adding it to the oil, and noting the time in which it sets to a solid mass; *seven grams* of the acid thus prepared are added to *nine grams* of oil; at 5 degrees olive oil sets to a solid mass in ten minutes, and after twenty-four hours is a white, hard mass.

Arachis oil, rape oil, and cotton oil get solid later, in about an hour; while sesame oil, after twenty-four hours, is still as soft as honey. Mixtures of oils of slow solidifying properties with olive oil, are, in proportion to their percentages, slower of coagulation. Here, as in all other cases, a pure sample of oil for comparison is an essential. M. Lipowitz has proposed the following as a special test for poppy oil: If one part of chloride of lime be added to eight parts of olive oil, the latter, if pure, separates completely

into two layers at the end of four or five hours, the temperature being from 17 to 18 degrees; but if it is mixed with an eighth or more of poppy oil, the separation is incomplete, and takes place with extreme slowness. According to M. Lailler, every olive oil must be considered false which, when mixed with one fourth of its weight of chromic acid, does not, at the end of twenty-four hours, present a perfectly opaque liquid. According to Chevallier, in one part of France the oil is sophisticated with honey, an adulteration not likely to take place in England. It is easily discovered, for the oil has only to be shaken up with water, and the water separated and submitted to the usual tests for sugar.

METHODS OF DETECTING ADULTERATIONS IN OLIVE OIL.[*]

Southern France has of late years suffered seriously from the adulteration, or rather the artificial fabrication of her two principal agricultural products, wine and olive oil. During the recent season of scanty vintages there has grown up in wine districts an immense manufacture of "piquettes," or raisin wines, which are made by soaking in water until fermentation takes place the cheap dried grapes which are imported in vast quantities from the Grecian Archipelago and Turkey. These substitutes have so far replaced the real but more costly French wines, that now, since the replanted vineyards begin to yield more abundantly, the genuine ordinary wines command only prices which hardly repay the cost of culture.

The consumption of vinous beverages among the laboring classes has not diminished, but the cheaper substitute has crowded out the real article; and in behalf of the agricultural class it is proposed to remedy this unnatural difficulty by putting a heavy import duty upon dried grapes from the Levant.

With olive oil the case is similar, but even worse. Only a small portion of France is adapted to olive culture, the entire available district being a strip of dry country less than two hundred miles wide along the Mediterranean coast. The tree is of slow growth, and is, moreover, beset by numerous insects and diseases, which, in addition to unfavorable phases of weather, render the yearly olive crop more or less uncertain. Any serious reduction in the annual consumption of olive oil is sufficient to reduce its market value below the point of profitable culture. This has been done by the now nearly universal practice of adulterating or diluting the olive oils of Nice and Provence with various seed oils, viz.: sesame, peanut, poppy seed, cameline, and especially cotton seed; which last, by reason of its cheapness, palatable flavor, and difficulty of detection, has, of recent years, nearly supplanted all the others as an adulterating material.

The rank, low priced olive oils from Southern Italy (Bari), Algeria, and Tunis have been brought here in vast quantities, diluted with cotton or sesame, and been consumed and exported wholesale in place of the fine, delicate, high grade oils of the Var and Bouches du Rhone, which have thus been nearly elbowed out of the market. This has so reduced the value of olive oil in Southern France that the Government has set itself seriously to the task of providing a remedy. The first step was to discover some method of detecting such adulterations which should be not only exact in its results, but sufficiently simple to be practicable for farmers, dealers, and ordinary consumers. It was stated in a report which was made by this Consulate in February, 1888, that no such process was then known. As late as the seventeenth of May last, a meeting of the Scientific and Industrial Society of Marseilles was addressed by Mr. Ernest Millian, an accomplished analytical chemist, who reviewed elaborately all of the known processes, and admitted that none of them were sufficiently delicate and exact to detect an adulteration of less than 10 per cent. The "Cailletet" process, which consists in treating the oil with a mixture of sulphuric and nitric acids, has been hitherto generally employed, but this was declared by Mr. Millian untrustworthy unless the degree of adulteration exceeded 20 per cent.

---

[*] Report of Consul Frank H. Mason, Marseilles, July 31, 1888.

The "Bechi" process, now used by the Italian Government, will detect an admixture of 15 per cent of cotton-seed oil, provided the sample analyzed contains no glycerine, formic acid, or free fatty acids, any one of which, even in minute quantity, is sufficient to mask the chemical reaction upon which the process of Signor Bechi depends.

Mr. Millian then described a new method, invented by himself, which consists in treating with heat the saponified products of the oil in alcoholic solution with nitrate of silver. This, however, is a process for the laboratory of the accomplished chemist, and is not adapted to general use. The same is true of the "Levallois" process, which has been used by experts in cases of real importance with more or less questionable results, the analysis in one notable instance having given the same result from a sample of pure olive oil and another which was known to contain 20 per cent of cotton seed.

Finally, as it would seem, the long-sought-for process has been discovered by Mr. Brullé, chemist of the Agronomic Station, at Nice. His discovery was announced to the Academy of Science, in April last, and has been since subjected to an elaborate series of tests and experiments by a Commission specially appointed for the purpose by the Agricultural Society of the Alpes-Maritimes.

Mr. Brullé began upon the known principle that vegetable oils, when oxidized by the application of certain acids, assume different shades of color. He then hit upon the use of albumen to fix and accentuate these delicate graduations of tint. The report of the Commission has recently been published and gives the process of Mr. Brullé such complete and unqualified indorsement, both for its simplicity and the exactness of its results, that the subject assumes a practical importance, not only to the countries which produce olive oils, but to those which, like our own, import them as costly luxuries for general consumption.

In its series of experiments at Nice, the Commission first applied the process of Mr. Brullé to six classes of samples, viz.: First to pure olive oil, then to the same oil with an added admixture of 5, 10, 20, and 50 per cent, respectively, of cotton-seed oil, and finally, to the pure cotton-seed oil itself. When the result had been established by repeated experiments with each grade of samples, a *fac simile* of the tint produced by each successive degree of adulteration was prepared by dissolving certain aquarelle pigments in stated quantities of water. Thus the process and a standard system of proofs was put within reach of any person having a good eye for color and a slight familiarity with chemical manipulations.

THE NEW PROCESS.

The process of Mr. Brullé is as follows: Put into a test-tube one and one half grains of pure albumen (this should be gently heated in the flame of an alcohol lamp to expel any remaining moisture in the albumen which might otherwise modify the exactness of the result), then add three parts of nitric acid and ten parts of the oil to be tested (the quantity of each ingredient used is, of course, immaterial, provided the above relative proportions are maintained; a test-tube graduated metrically is the most convenient for the purpose), the mouth of the tube is then closed with a cork to prevent the boiling over of the liquid during ebullition, but pierced with a small orifice to permit the escape of vapor which would otherwise explode the tube. The materials are mixed by shaking, but the nitric acid quickly settles to the bottom. Now, warm gently in the lamp the part of the tube containing the oil, then apply the flame to the underlying stratum of acid. A fierce ebullition soon ensues, and when this is at its height, plunge the tube into ice water sufficiently cold to chill the contents to 4 degrees Centigrade, or its equivalent, 40 degrees Fahrenheit. During the cooling process there is developed an oleaginous precipitate, ranging in color from pale yellow to reddish brown, according to the proportion of cotton-seed oil contained in the tested sample. The experiment requires only the simple apparatus above mentioned, and occupies only four or five minutes.

The findings of the Commission at Nice are tabulated in its official report as follows, the standard tint in each grade being produced by dissolving a stated number of units of each pigment named in one hundred units of water; for this purpose ordinary dry cake water colors are most convenient:

1. Pure olive oil yields a precipitate tinged like five units of Naples yellow dissolved in one hundred units of water.
2. Olive oil containing 5 per cent of cotton oil yields the tint of five units Naples yellow and five units of dark chrome yellow in one hundred units of water.
3. Olive oil containing 10 per cent cotton seed yields a tint equal to twenty units Naples yellow, six and one half units chrome yellow, and one unit Chinese vermilion, in one hundred units of water.
4. Olive oil containing 20 per cent cotton seed yields a tint equal to six and one half units Naples yellow, six units chrome yellow, and one and one half units Chinese vermilion, similarly dissolved.
5. Olive oil with 50 per cent cotton oil yields a tint equal to five units Naples yellow, five units chrome yellow, and five units of vermilion.
6. Pure cotton-seed oil yields a precipitate having the color of three and one half units chrome yellow, ten units of vermilion, one unit of burnt sienna, and one of natural sepia, in one hundred units of water.

Other seed oils, including sesame, cameline, peanut, and poppy seed, give a precisely similar series of tints in proportion to the degree of their admixture with olive oil, except that the colors are more inclined to the reddish shade, which would be produced by covering the corresponding cotton-seed tint with a thin wash of carmine.

These gradations of color are most marked when the liquid in the tube is at about the stated temperature, 40 degrees Fahrenheit. As the precipitate is further chilled to the freezing point, the colors fade and lose their individuality.

Such is the system which is now expected will enable purchasers and consumers of olive oil to detect the adulterations, which have become so general that very few brands or firm names are any longer a guaranty of purity. When it is remembered that more than two million gallons of cotton-seed oil are exported from the United States to Marseilles in a single year, and that more than half of this vast quantity is used for adulterating olive oils, a large part of which are reimported to the United States through a 30 per cent duty, the importance of some new and better means of controlling the integrity of this trade will be apparent.

Two weeks ago one thousand tierces of American lard were stopped at the wharf in Marseilles and the consignees subjected to a costly process, which is not yet terminated, because the lard was found upon analysis by the custom officers to contain 10 per cent of cotton-seed oil.

This seizure was based upon the fact that, while lard is entitled to entry duty free, cotton-seed oil bears a duty of $1 15 per two hundred and twenty pounds, and this adulteration of a free article with a dutiable one is held to be fraudulent. The least that can happen to the shippers in this case will be that they must pay the duty on one hundred tierces of cotton-seed oil and the expenses of the process, besides the loss which the consignee suffers from the delay. Might not this rigid scrutiny be equally well applied to some of the adulterated and falsified foreign products which are landed at American ports?

It is not within the scope of this report to consider whether either lard or olive oil, when adulterated with cotton seed, is necessarily unwholesome. The vital fact is that in paying from 20 to 25 cents per pound and 30 per cent duty on American cotton seed as olive oil, the people of the United States are submitting to a wholesale fraud, the proportions of which are increasing year by year.

The interests of both the United States and France will be subserved when this reckless tampering with the integrity of commerce is systematically suppressed. As long as our people will accept and pay for adulterated oils they will continue to flood and dominate the market. The remedy must be applied at our ports of entry.

THE MILLIAN PROCESS.

In an article in the "New York Drug Reporter," Mr. E. Millian describes the following process for the detection of cotton-seed oil in olive oil:

The method described by E. Millian is based upon the reducing action of the fatty acids contained in cotton-seed oil. In a porcelain dish, holding about 11, 15cc. of the oil are heated to about 110 degrees C.; then with continued heating a mixture of 15 cc. soda solution of 40 degrees B., and 15 cc. alcohol of 92 degrees, is gradually added. As soon as the boiling mass shows a uniform consistency, as an indication of perfect saponification, about 500 cc. water is added, drop by drop to prevent cooling and the formation of lumps.

After a few moments boiling the fatty acids are separated by means of a 10 per cent solution of sulphuric acid. When the separation is complete, and the sulphuric acid present in excess, about 5 cc. of the fatty acid mixture is removed with a silver spoon, and poured into a test tube, having a diameter of about 3 cm., and 12 cm. in length, after which 20 cc. alcohol of 92 degrees is added. To the solution is added 2 cc. of a solution of silver nitrate (30 gms. to 100 cc. water), and then the tube is placed in water, and heated until about one third of the mass is evaporated, whereupon the tube is removed, and the operation completed.

Whatever the origin of the olive oil, the fatty acids will remain unchanged in case the oil is pure; if, however, it contains cotton-seed oil, a reaction will be observed whereby the silver is separated in the metallic state, and the black colored mixture of fatty acids will rise to the surface.

The chemical reaction, which is analogous to the aldehyde reaction and very delicate, will, with certainty, indicate the presence of 1 per cent cotton-seed oil in olive oil. This method also avoids all sources of error, cause it does not operate with the oil which may contain foreign reduc- odies, but only with the fatty acids which have been freed from all es.

XIV.

THE FIG.

FIG CULTURE.

The fig (*Ficus carica*) is one of the oldest of cultivated fruits on record. It is probably a native of the eastern Mediterranean regions, but is now so widely spread throughout the warm-temperate, sub-tropical, and northern-tropical zones, that it is a difficult matter to hazard any conjectures as to its original source. It grows in the planes of northwest India, on the Himalayas to an elevation of five thousand feet, Afghanistan, north Persia, Asia Minor, Palestine, north Africa, and the warmer parts of Europe, ripening its fruit in sheltered situations in the south of England. It is naturalized in Australia, the north island of New Zealand, Chili, California, and other parts of the United States.

The fig is a deciduous tree; it requires about the same degree of temperature as the olive to ripen to perfection, but will ripen its fruit where the olive could not. The edible part of the tree is not really a fruit, but is the hollow receptacle containing the flowers, in the pulp of which the seeds are buried.* Figure 5, Plate III, represents a longitudinal section of the fig (White Adriatic Cal.), showing the fruits inclosed by the fleshy conceptacle, which is only an enlargement of the peduncle. The flowers are very small and unisexual, the male flowers occupying the upper and the female flowers the lower part of the cavity.

The fructification and vegetation of the fig is uninterrupted where the mean temperature does not sink below 53 degrees Fahrenheit; but where the temperature descends below this mean, the leaves fall, and the fruit presents a curious phenomenon. A branch only develops and ripens part of the figs borne upon it—those on the lower end, nearest the stem. The immature figs at the further end of the branch have their growth arrested by the first cold weather, and remain dormant during the winter, resuming their growth the following spring, and ripening in the summer. These are known as "first figs" or "summer figs." Those which commence their formation in spring on the lower part of the branches are called "second figs" or "autumn figs." In our warm climate there are thus two crops from the same tree every year. In colder climates the "first" or "summer" figs form the whole crop, as autumn figs can only be produced in unusually warm seasons. In a warm climate the autumn crop will yield most figs, which are sweeter, less watery, and better suited for drying than summer fruit.

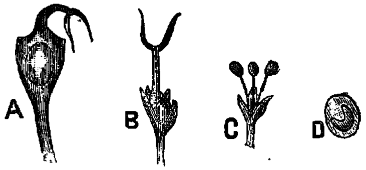


Figure 27.

A. One of the fruits of the fig; B. One of the pistillate flowers; C. One of the staminate flowers; D. Seed with embryo; all enlarged.

As to when the fig was subjected to culture by man is difficult to say, and one can only recall that mention is made of the fruit in the most ancient book of the world, that is to say, Genesis; that the Greeks cultivated it, as is evidenced by the writers of the country; and that Pliny relates how in his time there could be seen in Rome, precisely on the piazza where the people used to meet, a fig, grown there naturally, which was the object of the greatest respect, from the fact that Romulus and Remus had been suckled by a she wolf under it. Another fig, in the time of this same author, was religiously preserved in the forum of Rome, at the place where existed the abyss into which Curtius precipitated himself.

---

* R. C. Haldane, "Subtropical Cultivations and Climates."

The fig is the faithful companion of the olive and the vine, and where these two plants thrive it also grows and fructifies. It is necessary, though, that the plants be never subjected to a cold more intense than 10 degrees (14 degrees Fahrenheit). If the temperature exceeds this limit it is necessary to head the fig very low, as is practiced at Argenteuil, in France.

The long cultivation to which this plant has been subjected, in greatly different countries, has given rise to a very large number of varieties, a few of which only were known to the ancients. In fact, Cato mentions but six, and Pliny, two centuries later, carried the number to about thirty. Thus, by the side of the figs of Tivoli and Herculanum, mentioned by this writer, are indicated those from Rhodes, Lydia, Hyrcania, and others, which, like the *Liviani*, the *Pompeiiani*, got their names from their introducers and propagators.

To-day the number of fig varieties is so great that it would require a long study to be able to describe them all, and such a task would not be one of the easiest, inasmuch as a great many of these varieties possess some peculiar characters and habits, which might be observed and recognized through experience, but could not be described exactly without much difficulty. Suffren, who lovingly devoted himself to the study of the varieties of figs which were cultivated in Provence in his time, found that their number exceeded several hundreds. The figs may be classed into two large groups, the first of which comprises the varieties that yield only one crop of fruits a year, be they early or late, and the second, the other varieties which to a first yield add another, called September fruits, to distinguish them from the first, which are called flower or first figs.

VARIETIES.

In the report of the Minister of Agriculture of Italy, for 1886, the following very interesting account appears concerning varieties:

We have the *Fico gentile* and the *Fico portoghese*, both precocious. The first is common, under the indicated name, in the Neapolitan district, in the province of Rome, and in the Tuscan province, in some parts of which, as at Pistoia, Lucca, and in Lunigiana, it is known under the name of *Fico d'oro* (golden fig). According to some, this fig, the earliest of all, would be the *Tiburtinus* of Pliny or at least an analogous variety. The *Fico portoghese* is very common in the Florentine country, and does not seem to have issued from Tuscany, as it is not found in Liguria, nor in Milanese, nor in Umbria, nor in Romagna, nor in the neighborhood of Rome. It is uncertain whether it be cultivated in the southern provinces or in the islands.

The following varieties are backward and *uniferous* (yielding only one crop yearly): The *Verdini*, very common in Tuscany and different from the *Verdini* of the Veronese and from the *Verdecci* of the Bolognese; the *Brogiotti neri* (black September figs), universally appreciated throughout Italy; the *Brogiotti bianchi* (white September figs) of Liguria, which some people esteem nearly as much as the delicious figs which come from Smyrna in the dried state; the *Fichi brianzosi*, native of Brianza and much

THE FIG. Plate III.

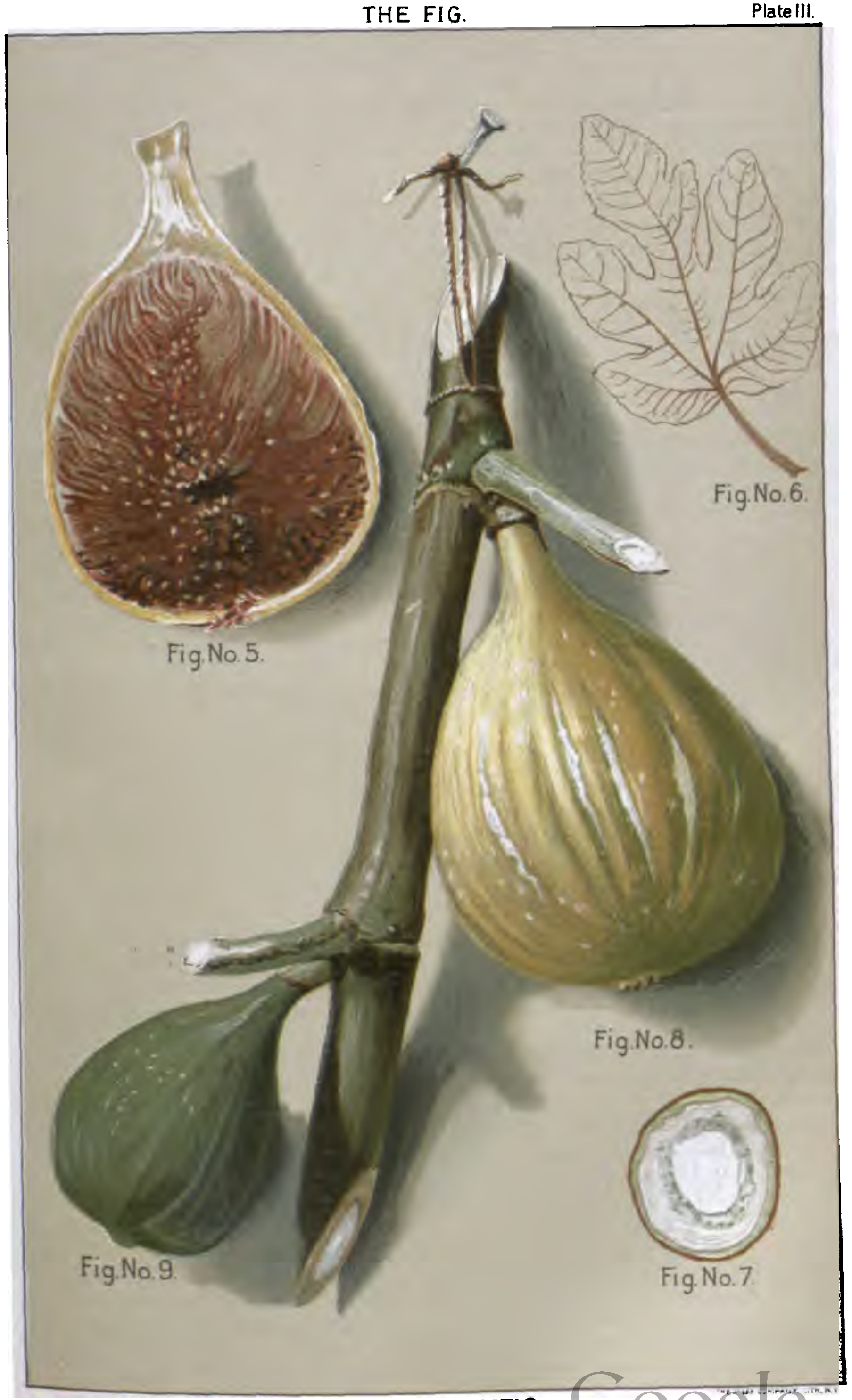


Fig. No. 5.
Fig. No. 6.
Fig. No. 8.
Fig. No. 9.
Fig. No. 7.

WHITE ADRIATIC. (TWO-THIRDS NATURAL SIZE.)

cultivated in Milanese, and finally, the *Datteri* (date) and the *Dottati*, the latter of which is deemed one of the most exquisite varieties. It appears that the *Dottati* figs of the Tuscans, *Ottato* of the Neapolitans, does not differ from the one which Pliny says was brought by Lucius Vitellius from Soria to his villa at Alba, and which corresponds to the *Grascello* of Mattioli, to the *Binellone* of Spezia and of Chiavari, to the *Binello* or *Fico di Napoli* (Naples fig) of the Genoese, to the *Gentile* of Voltri, to the *Napoletano* of Finale, to the *Datterese* or the *Calabria* of the remaining western Liguria, and lastly, to the fig *Della goccia* or *Della goccia d'oro* of the hills of the Lombardic Apennines from Voghera to Bologna.

The demand for Tuscan figs is very small, and for this reason they are mostly reduced into powder to make coffee, as is practiced in some parts of Germany. The variety used in the preparation of dried figs is called *Dottati*, which they peel (after that they are said *mondi*, clean) and dry in the sun, then season with a few grains of anise seed, and finally dispose in disks or loaves more or less large, resembling cheese in shape. These figs, besides their very sweet and delicate flavor, preserve a whiteness rarely seen in even the best figs imported from Smyrna or other places in Greece and European Turkey. At other times, these same *Dottati* figs are not stripped of their skin, but they are cut in halves and seasoned with anise or fennel seed, and then united again two by two, or, as the Tuscans say, *a piccie*, or else they are dried, strung on thin branchlets of genet or osier (*willow*). The black skinned figs are more common, and they are neither sliced nor seasoned, but they are dried in the sun; and if this is not sufficient, they are put into ovens immediately after the confection of the loaf.

Eleme, a name given to Smyrna raisins; the best quality are known as "Eleme." Raisins of a somewhat inferior quality are known as "Lexias." (Enc. Brit., Vol. XX, p. 258.)

Elemi, a raisin thus termed in modern pharmacy, obtained by incising the trunk of a species of *Canarium* found in the Philippine Islands, used chiefly in the manufacture of spirit and turpentine varnishes. The word elemi, like the older term *animi*, appears to have been derived from *enhaemon* (Greek), the name of a styptic medicine, said by Pliny to contain tears exuded by the olive tree of Arabia. This tree, according to Fluckiger and Hanbury, is probably to be identified with the *Boswellia Frereana* of Birdwood, which flourishes in the neighborhood of Bunder Marayah, west of Cape Gardafui. Mexican or Vera Cruz elemi, formerly imported into England, is afforded by the species *Amyris elemifera*, Royle; Mauritius elemi by another tree, Colophonia Mauritiana, and Brazilian elemi by several species of *Icica*. (Enc. Brit., Vol. VIII, p. 122.)

Among the biferous varieties may be mentioned the *Fico albo* (white fig), very abundant in Tuscany, and grown also, but under various names, in the territory of Como, in Vogherese, in Piacentino, in Bologna, in Modena, and in Parmigiano; the *San Piero* fig of the Tuscans, which is the *Fico arbicone* of the Genoese, the *Nero* of the Sardinians, *Minna di shiaro* of the Sicilians, and the *Fallogiana* or *Pitlilonga* of the Abruzzese. Beyond the Apennines, this fig does not seem to spread much, and, indeed, it is not known by either the Lombards or the Piedmontese.

XV.

PREPARATION OF THE FIG.

Fresh figs are toothsome fruits, but little nutritious, and not seldom, rather indigestible. The dried figs are the most valuable, which are reduced to this state either by artificial or natural heat. The experiments made during this and last year proved conclusively the fact that natural heat is the best, and produces better fruit. Before mentioning the processes in use in this State, I will briefly describe the processes in use in foreign countries; and while many, and, perhaps, most of them, could not be put into practice in this State, many good ideas are derived from them.

The Tuscans dry them loose, and make loaves of the whitest and the sweetest. In the southern provinces they are strung on small canes or flexible branchlets of holm oak or of other plants.

The same mode of operation as in Tuscany, is followed in the Marches, in Umbria, and in the Abruzzi, and if there be any difference, it exists only in the divers varieties of fruits used and the manner of handling and dressing them.

At Naples, as already stated, the production of dry figs is rather insignificant owing to the great consumption of figs in the fresh state. This industry, however, begins to assume a greater importance in some parts of the province, as, for instance, in the District of Pozzuoli, concerning which the Agricultural Association reports as follows to the Ministry:

"The dried figs confected in this district are to be considered as a commercial product, both at home and abroad, but the export is very limited. The preparation of dry figs is simple. As soon as gathered the figs are dried, some peeled, some in their natural state, and others divided in halves down to the stalk; the latter are afterwards united in pairs, or else made into various shapes, such as small slabs, hearts, and the like. Those which on account of rain or other circumstances are not in a condition to be dried in the open air, are put into ovens.

"The figs thus prepared are thin, light, and of very agreeable taste, because grown on a volcanic soil, and they command a higher price on the Naples market than the dried figs from the Calabrias and other localities."

In the neighboring province of Salerno the production of dried figs begins to acquire a greater importance, that is to say, in some places, since in the District of Campagna, according to the Agricultural Association, the figs are not fit to be dried. On the other hand, the figs prepared in the Vallo of Lucania, are esteemed, and the Agricultural Association speaks of the industry:

"The fig thrives pretty well in the southern part of the district, and particularly on lands bordering the Mediterranean Sea. Its production constitutes one of the leading articles of trade of these places, and the dried figs, said of Agripoli, where there is a landing at which ships take on their cargoes, are renowned abroad, especially in France and America.

"The system of exsiccation is very simple. The figs are gathered when well ripe, spread over a lattice, and exposed to the action of the sun. Care is taken to turn them over alternately every two days, and subsequently the more perfect are separated from those that are less so, the first constituting the better quality and selling at a higher price, while the second are dried in an oven at a moderate temperature, and form the inferior grade, selling at a lower price."

Where, however, the preparation of dried figs assumes really the characters of an agricultural industry, being carried on on a rather large scale, is in Terra d'Otranto and in the three Calabrias, that is to say, in the provinces of Cosenza, Catanzaro, and Reggio.

The production of dried figs is of great importance in the province of Lecca, and we find, in the reports of the Chamber of Commerce of this country, that in the only two communes, that is, those of Cutrofiano and of Galatina, there was prepared, some years ago, about one million two hundred and fifty thousand pounds of this produce, and that the increasing plantation of figs foreboded a sensible augmentation. But there, also, the preparation of this class of goods could be much improved; and, in fact, we read in a report by the Agricultural Association of Lecca:

"The preparation of dried figs should be still further improved by introducing among us appropriate hot air stoves to accelerate the desiccation of spotless fruit, especially in rainy summers, and when the harvest is very plentiful and of good quality, and to prevent the easy fermentation which often takes place during the natural desiccation under the burning rays of the sun; as also in the matter of æsthetics, that is the external appearance, since our figs may be served on the table and are not merely used, as is sometimes the case, to make alcohol."

Three Agricultural Associations of the province of Cosenza have sent the following answers to inquiries from the Ministry on this subject:

Agricultural Association of Cosenza: "The dried figs represent for this province a pretty important article of export trade.

"The preparation of these dried figs is very simple. They are dried in the sun, and then packed in small baskets made of strips of chestnut wood interwoven very closely.

"The method of drying, though simple, is undoubtedly uncertain, and it frequently happens that in the latter part of summer, or at the beginning of autumn, the figs cannot be dried, and spoil, owing to repeated and excessive rains; people then have to resort to the artificial heat of ovens, and the fruits prepared in such a manner fall sensibly in price."

Agricultural Association of Castrovillari: "Although the soil and climate favor the cultivation of the fig in this district, it cannot be said, however, that the product of confected dried figs forms the object of a large trade, either at home or abroad.

"They are never prepared in any other way but by drying in the sun, and sometimes cooking in the oven, especially those of inferior quality, called *Fichi bruni* (dark figs), on that account."

Agricultural Association of Paola: "Some of the dried figs prepared in this district are exported, and a great quantity forwarded to the principal markets of the kingdom.

"The greater part of the dried figs put up for the trade are confected after desiccation in the sun. The figs are confected in various ways, being strung or made into a kind of tress, formed into small globes wrapped in fig leaves, or shaped like stars. Some are stuffed with walnuts or almonds and seasoned with thin shavings of citron peel or cinnamon or cloves, and then put into the oven to serve as sweetmeats; or else they are dipped into honey and cooked in a copper-lined kettle or pot, being afterwards put up in varnished earthen vases. The dried figs prepared according to the latter method are sent as gifts to friends, and a very small quantity finds its way to the markets of the principal cities of the kingdom, and of foreign countries. These figs are dried only when perfectly ripe, and care is taken to preserve them from the inclemency of the weather and from the dew, as well as from white frosts.

"The communes of this district which do not sell any, are: Paola, Amantea, Belvedere Marittimo, Belmonte, Longobardi, San Lucido, Scalea, Cleto, Serra di Ajello, Fiumefreddo, Santa Domenica, Jalao, Maiera, Orsomarso, and Verbicaro."

As to the province of Catanzaro, we reproduce here the careful and detailed report made to the Ministry by the Agricultural Association, concerning all what relates to the dried fig industry:

"The custom of drying the fruits of the fig is very old, and almost general in the southern regions of Calabria. The output of this industry—arising probably at first as an auxiliary means to relieve the economical wants of the poor country people during winter, their produce meeting with a general welcome where, by reason of climate, the fig does not grow—advances in proportion as it is favored by the physico-geographical conditions of the soil and the special skill of the farmers. The principles which regulate its progress lie in the selection of the species, in the degree of ripeness of the respective fruits, in the time of their gathering, and in the mode of drying them. Of the many figs, counting over twenty-four varieties in this country, the only ones found, through experience, as fit for the industry we speak of, are the *Dottati* and the *Petrongiano;* the fruits of the second crop being mostly used; that is, those growing after the *flower fruits*, from the month of August to the end of September. None of the other varieties succeed here, giving products that are soft, viscous, unsavory, and spoil in a short time. To the choice of varieties must be added the complete maturation of the fruits, which must be effected spontaneously and without violent means. In good practice, the figs are considered as having acquired the desired degree of ripeness when they hang from their stock vertically and are wrinkled on the surface.

"The state of the atmosphere when gathering is of the utmost importance. The best time for carrying on this work is immediately after sunrise, and properly after all traces of dew have disappeared from the tree. Damp air, white frost, and rain of any intensity endanger the success of the product. Having ascertained the maturity of the fruits and the favorable concurrence of the atmospherical circumstances, the gathering is proceeded with daily, particular care being had not to tear nor strip the delicate epicarps in any way, and to pick each fruit together with its peduncle. This done, they are at once spread horizontally over large networks of canes previously arranged like raised floors, well aired, well sunned, and protected from the dust which the wind might cast over them. The fruits successively gathered are laid over separate lattices, in order that they may be all subjected to a uniform treatment. They are turned over several times a day during the whole period of exsiccation, and care is taken to separate the smaller fruits, and those of poorer grade or decayed. After twelve or fifteen days of such treatment, the figs, owing to the evaporation produced by the solar action, become white and dry externally, pulpous and sugary internally, properties which they preserve for several years, especially if not kept in fresh places and exposed to the air. In fact, arranged in baskets of the moderate capacity of thirty-three to forty-four pounds each, they withstand long journeys by land and by sea without spoiling at all. There are many here who, to advance more diligently the drying of the figs, cut them vertically into halves, and after desiccating, readjust them in their natural position, and form them, by the aid of small cane sticks, into rectangular tablets. Often there is introduced between the two parts of the fig bits of walnut or small pieces of candied citron, to make them agreeable to the palate.

"Whenever the season is rainy at the time of ripening of the figs, the exsiccation is made in ovens, this being done also for the fruits that are too backward or become spoiled through any cause. These figs, although of lower grade, acquire yet an exquisite savor and are much in demand among the poorer classes."

There are, in Reggio di Calabria, a great number of lands planted to figs, and great is therefore the production of these plants in that country and the quantity of fruits dried. Speaking of this industry, the Agricultural Association of the chief town of that province thus expresses itself:

"The confection of dried figs is effected in our country by gathering the fruits when perfectly ripe, and precisely those of autumn, said of *seconda mano* (second crop).

"From these the largest are chosen, and they are cut in two lengthwise, spread over large hurdles, and exposed to the sun to dry. When the figs thus prepared appear dried, they are strung on small canes, forming tresses of various sizes, or made into squares, called *tavolieri*, or similar odd designs.

"The smaller figs are dried whole as picked, and preserved separate, they being known under the name of *cuzzoli*."

Other notes on the same subject are furnished by the Agricultural Association of Palme, which says:

"The figs grown in this district are eaten fresh, and what little is left over are dried for winter use in the well regulated families. As a general rule, the dried figs consumed in this district come from the neighboring district of Gerace, where there are very large plantations of that sort of tree. The preparation of these figs is effected with little care. The larger ones are cut longitudinally down to the stalk, and spread confusedly over small hurdles. These are exposed to the sun, and in the mountainous regions, where the figs are late in ripening, their exsiccation is completed in bakeovens."

We have also noted from the Agricultural Association of Gerace, on the importance of the production of dried figs, which is said to be a source of great profit for the district. The figs grow to perfection in that territory, but, as confessed by the same association, their drying is rather defective. Generally the figs are picked when imperfectly ripe, then cut in halves and exposed to the rays of the sun over hurdles, care being taken to turn them often. After the fruits thus treated are dried, they are strung on cane strips, or else on thin green withes, and exposed anew to the sun, or to artificial heat to complete their preparation.

The soil and climate of the greater islands, Sicily and Sardinia, are no less adapted to the culture of the fig than those of Calabria, and great is therefore the production of this fruit in that part of the country.

The Agricultural Association of Palermo says that the best quality of dried figs produced in this province come from the communes of San Fratello and of Pollina, in the Madonie. The preparation is of the simplest, and generally the solar heat alone is used. "As to the preparation," says the association just mentioned, "the figs most prized are those disposed in tablets, which last longer and are preserved better. They have also those that are cut and then arranged in pairs in form of tresses, which become mellower and preserve a greater quantity of saccharine matter. There are, lastly, the figs called *messinesi* or *neri*, which are dried separately, without being cut, and, as they preserve their skin, become coriaceous and keep longer than the others."

For the province of Messina, we have the following notes from the same Agricultural Association:

"The dried figs of this district may be considered as a commercial product intended more for home consumption than for export. In fact, some small vessels from Trapani and Naples come into the port of Milazzo, in the month of October, to take cargoes of this produce and transport them to Trapani or to Naples. The islands of Lipari, which give the most exquisite figs of the district, send also their small production abroad. The City of Messina, on the contrary, receives dried figs from the nearest Calabria. Everything considered, however, we can reckon that the production is limited to the consumption of the inhabitants.

"The dried figs are prepared in the following manner:

"The figs are picked rather ripe; then they are cut through the middle with a knife and spread over hurdles in the sun. The fruit being dried internally, the side of the skin is turned up. When well dried the villagers perform the operation of putting the fruit *a pania*, as they commonly call it there. The *pania* is composed of the sixth part of canes cut to a point, all the figs being fixed two by two, between two of these canes; thus they form quadrangular plates about twenty inches in length, and of the width of a fig that has been opened and spread out, that is to say, about four inches. These *panie* are exposed for a few days to the sun so as to dry them still better. The harvest and exsiccation being wholly completed, the farmers wash all the *panie* with fresh water and set them out in the sun for another day. All this being done, the figs are preserved for the winter in chests or pantries, or else they are sold to speculators."

Information still more precise than the preceding is given for the province of Catania by the Agricultural Association, which, in answer to queries from the Ministry on this subject, thus expresses itself:

"The cultivation of figs is rather extended in the district of Catania, and especially in all the *allodii* (freeholds) of the Etna region, where the fig is spontaneous. Many are the varieties of figs, both early and late or backward, grown in this district, and the markets are supplied with fresh figs from the end of July to the end of December.

"The first white figs are called *Auttati*, better named *Agostani*, and the black, *Fichi melongiane;* the last are black and small, and called *Nataline*, or *Natalinedde*, because they ripen about Christmas time.

"The fresh figs are consumed where they are produced, being as healthy a food as grapes and the opuntia (Indian fig or prickly pear). Part of the fresh fruit, however, is exported outside the province, particularly to some places in the provinces of Syracuse and Caltamissetta. Both the white and the black figs which ripen in the months of October and November are dried.

"The desiccation is done in two ways. If the fig be small, then it is dried whole with the peduncle; but if large, it is opened in two with a knife, and thus reduced it is exposed to the solar rays over hurdles, the fleshy part up. In the first case, the figs are said to be dried *a passuluni*, in the second, *a chiappa*.

"As soon as the figs are deprived of that honeyed juice, which renders them rather soft, they are subjected to the following treatment: The *passuluni* are strung on thin rushes, or on twigs of *ligara*, called also *liami*, or else on slivers of cane, which are disposed in squares, that is, the slivers are fixed to two strips of ferula. The figs *a chiappa* are formed by the reunion of two figs, placed one over the other on the fleshy side, leaving outwardly the side of the skin. In this manner the two halves of the *chiappa* are pierced through the center by *ligara* or *rushes*, as above, and the *chiappa* are then superposed one over the other. The *passaluni* and the *chiappa*, having been united, water is set to boil, and while boiling, the figs thus prepared are immersed into it for a few minutes, in order to prevent any fermentation that might take place, and then they are put out anew in the sun to be dried again. This done, the *passaluni* squares are put away in dry places, those that are strung are rolled together spirally, and the same is practiced for the figs *a chiappa*, thus giving wheels of *passaluni* figs, and of figs *a chiappa*, which are named *scerti di ficu*, and are preserved as the best.

"In some places the white figs are distinguished from the black, and there are then white and black *passaluni*, and white and black *scerti di ficu*. Sometimes, when the figs are big and pulpous, they are dried in *scerti* stripped of their skin; then they are called *ficu senza scorcia*.

"The dried figs serve as food to both the rich and poor, in winter and spring; they are not used later, since the dried fig is held as heating. The dried figs are also exported; thus from Porto di Catania shipments are sent to the Calabrias, and even to Malta, from where they are transported to still more remote countries. The dried fig industry is more extended than that of prunes and that of dried opuntia (Indian figs), which are also practiced in the district of Catania."

The production of dried figs is less important in the province of Syracuse, concerning which the Agricultural Association says:

"In this district, the greater part of the figs are consumed in the natural state. What little are dried, are put up expressly for local consumption. The dried figs are prepared by exposing the fruit cut in two to the action of the sun until perfectly desiccated. As soon as dried, the halves are pressed together, and the reunited figs strung one over the other on strips of canes or pointed switches; then they are plunged two or three times into boiling water, care being taken to dry them anew in the sun afterward. This operation being completed, the dried figs are offered for sale."

As to the singular practice of immersing the figs into boiling water as soon as dried, it is explained in another report of the association aforesaid, in which we read: "They (the figs already dried) are plunged into boiling water to destroy the myriads of minute eggs deposited over them by insects, when the fruits are out in the sun."

The same Agricultural Association adds that in some parts of the southern provinces, and perhaps, also, in the islands of Sicily and Sardinia, the dried figs are strung on thin and sharp twigs from the *Lycium europaeum*, vulgarly *Spino santo*, or *Spino di Christo* (holy thorn—thorn of Christ), which grows spontaneously in hedges in the olive region, and in speaking of the systems in use, says:

"The marked difference in price is not due entirely to the diversity of material, but rather to carelessness and to the imperfect methods followed among us in drying the fruits, as also to the negligence brought in putting them up and giving them the final touches before offering them to the trade. The French and Spanish put up their products in such a way as to give them a nice appearance, even if the quality of these products be not the best. Among us, on the contrary, even the products of excellent quality are most often thrust confusedly into baskets, bags, sacks, or other vulgar recipients, and seldom are they gotten up in a more decent and proper manner.

"The bad systems of preparation in this country are the causes that dried fruits, and especially the figs, which represent the greater part thereof, are called for abroad almost exclusively for distilling purposes, and to make coffee powder or other similar articles. And this will last as long as no improvement is made in the modes of exsiccation, and until drying in moderately heated dry-air stoves, as is done elsewhere, be substituted for the imperfect methods presently followed. Our people trust in the power of the sun, but if this fails, the fruits ferment and sour before drying, and they at least lose their fine appearance. Then, what cannot be dried in the sun are put into ovens, which are so strongly heated that the fruits laid therein are almost carbonized. Whatever be the mode adopted, there is usually too little attention paid to the cleanliness of the hurdles or the tables over which the fruits are spread to dry, they being left for a long time exposed to all sorts of injuries on the part of insects, and covered with so much dust as to render them black and repulsive to look upon."

Concerning the cultivation of the fig tree in Smyrna, Consul Stevens of Smyrna reports:

"The cultivation of fig trees in the neighborhood of Smyrna and in the interior is carried on to a considerable extent. With the exception of the district of Aiden, the figs are excellent while fresh, but lose their flavor and color when dried. The figs so well known in the United States, England, Germany, and Russia are grown in the district of Aidin. When fresh, these figs are not palatable; when dried, they are delicious, and unrivaled by the product of any other locality.

"The planting of fig trees in the valley of the Meander, where are situated the fig orchards of Aidin, is performed in the following manner: Fresh branches (cuttings), about two feet in length, are cut from the tree and planted in a field which has been previously tilled seven or eight times during the warmest months of summer. The fig cuttings must be put in the earth to the depth of about one and one half feet, and at a distance of about twenty paces one from the other. As each branch is planted, a stick of the same thickness must be put by its side to keep it straight. Three or four times yearly the field is tilled with a plow, and then it is sown with corn or barley.

"The fig tree gives fruit the seventh or eighth year of its growth, but does not attain its maximum of yield before its twelfth or fifteenth year. It thrives at a distance of fifty miles from the sea.

"The fruit, perfectly ripe and partly dried, falls from the tree by itself, and is collected by the grower and spread in the sun for several days, on an even and clean surface, until it becomes fit for the market. The figs of superior quality are those collected when perfectly ripe, and while the north wind blows. Each tree yields on an average from forty to one hundred pounds of fruit. Trees one century old usually yield from two to three hundred weight. What would seem extraordinary is the fact that fig trees from Aidin planted in other localities never give good results; the trees grow well and become very strong, but yield fruit inferior in quality to the commonest local variety.

"The dried figs, packed in hempen bags of a capacity of two and one fourth hundred weight, are conveyed to Smyrna by rail and carried to the fig market, where packers and export merchants get their supplies. The fruit intended to be put up for export trade is carried to the packing establishment, where it is sorted into different qualities. It is then handed to workmen, who press it between their thumb and forefinger to soften and flatten it, and pack it in rows into small, shallow, wooden boxes or small drums. Packers in manipulating figs keep their hands wet with sea water, as it is claimed that brine hastens the sugaring of the fruit. Occasionally laurel leaves are placed between the rows of figs in order to improve their flavor and keep them free from moths. Figs of inferior quality are packed in wicker baskets or small hempen bags.

"In the transportation of fruits of all kinds from the plantations to Smyrna, or to the stations on the lines of railway leading to Smyrna, camels are employed to good advantage, the highways not being in a condition to permit of the use of carts or drags."

Consul Marston of Malaga, Spain, reports that the process used in Spain consists in packing the figs when they are entirely ripe, and are cured by laying them on the ground upon straw until they are cured by the sun. They are covered each night to protect them from the night dampness.

Throughout France the fig tree is common; about Marseilles it is not an object of special culture. There they cull the fruit one by one, when perfectly ripe, with great care to prevent them from bruising, or severing the fruit from the peduncle. They are then laid on hurdles and exposed to the sun, and turned over every now and then until perfectly dried, that is for a period of ten or fifteen days, as they claim that the least exposure to moisture would turn the figs black and reduce their value for at least one half. These hurdles are taken in every evening, to be again taken out every morning. The difficulties of the operation deter most of the farmers there from undertaking it, excepting those that own small farms, where everything must be turned to account, and they cultivate them themselves with no other help than that of their families.

The *Marseillaise* is considered there as the best variety.

Consul Heap reports that the process of curing the fruit throughout Turkey consists of picking the figs when ripe and spreading them out to dry in the sun, the sugar which they contain in abundance being thus rendered available for their preservation; those of better quality being much pulled and extended by hand during the process. Thus prepared, the fruit is packed closely in barrels, rush baskets, or wooden boxes, for commerce.

Figs are grown largely in the province of Turkey, but the quantity is small compared with Smyrna. A considerable quantity of inferior kinds of figs find their way to the Austrian "chicory coffee makers," and the French brandy distillers. Much liquor labeled "fine champagne," "cognac," etc., owes its origin to refuse of the Smyrna fig market.

Consul Fottion of Mytilene reports "that the kinds of figs producing the figs of commerce there are the *Politika* and the *Asprokoukouzza*, so called *Politika* from Constantinople, and *Asprokoukouzza* from their white seeds." These varieties there do not require any cultivation.

The figs are dried in the sun, and afterwards are filled with almonds, pepper, and cinnamon, and are roasted on plates in ovens. Aromatic leaves of laurel are added to them and they are then packed in boxes. In Syria, the process of curing consists in opening the fruit either by hand or cutting them with a knife, and spreading them for three days in the sun on dry ground or on a straw mat, placed on the house tops. When dried they are placed in palmleaf bags and pressed as much as possible. The figs are not gathered until they are fully ripe.

In Aleppo, the figs are gathered and spread on mats in the shade until they get dried and are then placed in bags and pressed. The best are selected, and when dried are steamed to make them fresh, after which they are pressed between the fingers and flattened, and are strung on flaxen threads to be exposed for sale.

In Damascus the figs are dried in the sun and are then cured by covering them with flour.

In Tripoli (Straits Settlements) the figs are gathered when fully ripe, and after breaking the fruit a little at the top they are exposed to the sun until they become dried and are then boiled together with fragrant herbs and stored for the winter.

In Central America the figs are gathered after having fallen to the ground the previous day, and laid in the sun (on mats made of reeds) until dried, which takes four or five days. They are then put into close boxes to sweat a little. Before packing they are spread in the sun just long enough to get warm, and are then pressed in seroons of rawhide. They do not pack in boxes because they claim that the fruit gets worm eaten.

Consul Mathews of Tangier, Morocco, reports that "the Jews extract '*agurdiente*,' an ardent spirit, from figs."

In Spain a savory wine is prepared, from which they extract spirits, which they flavor and term "*anisette.*" They cure the figs by gathering them when perfectly ripe and when they commence to dry on the tree. They are then placed upon lattice work made of canes, or slips of boards, or on rough straw mats placed on the ground, allowing, if possible, the air to circulate under them. The figs in a few days, when dried, are pressed one by one into shape, to facilitate their curing; when cured, and lastly, the figs are pressed downwards on a table to give them a round shape, then they are packed in boxes lined with paper.

XVI.

EXPERIMENTS IN FIG CURING.

During the past year I have carried on experiments in curing or processing the fig, for the purpose of determining the best method among those now in use in this State, as well as many which are published as emanating from foreign countries, and supposed to be the true processes in use there. I find that in most instances these foreign processes are published for the purpose of deceiving the public and to avoid American competition. The publications received from Italy, after being translated, gave me very little information, and in every instance the professors in charge of the departments recommended to the Government that to avoid competition the processes should not be made public. Through the aid of American Consulates, I obtained the foreign processes herein mentioned, as reported to the various Associations. While these processes are not such as can be put in use in this State, conditions being so different, yet they have been the means by which our experiments have been furthered.

I procured fruit from many districts throughout the State and submitted it to nearly all the foreign processes, and in almost every instance they proved unsatisfactory. If the methods that are given out as the true processes used in foreign countries are of any value there, they are certainly of but little use to us.

During the past few years we have accomplished a great deal in experimenting, and have been able to process fruit that is considered the best in any market. This is true not only of the fig, but also of other fruits, and they are to-day selling far in advance of the foreign article.

There were two orchardists in this State who had processed their prunes to make them resemble the foreign, and I have been informed that their commission agents refused to handle their fruit this year, as it was selling lower than that processed by the California method.

The process in itself should be simple and one that can be followed by growers, and also must be inexpensive. Of all the experiments made there were but two that I feel warranted in recommending, as they are simple and inexpensive, and such as can be put into use by the ordinary fruit grower.

Figs as a rule do not stand as much sulphuring as other fruits, and require the most careful attention. They cannot be transported any considerable distance to be processed, as they sour in transit and cannot be used at all. The only way that I find figs can be transported safely is by subjecting them as soon as picked to a sulphur bath. This stops fermentation, and after the figs have been exposed to the sun for half an hour or an hour, they can then be packed and shipped to their destination, but the packages should not be large, as the heat generated in bulk would again start fermentation, which even reëxposure to the sun would not check. It is not necessary to sulphur figs more than ten minutes. As stated before they will not stand as much sulphuring as other fruits.

Figs grown on low, moist lands which are not suitable for fig culture, change their characteristics, so much as to deceive some of the best experts in fig culture. Those grown on soil of a higher altitude and under most favorable conditions also change, and this has caused many to believe they have produced something new, and to give the supposed novelty a name of their own. This has greatly added to the already much confused nomenclature of the fig. The figs grown on low, wet lands, and in low lands in valleys, I find to have a much thicker skin, a larger cavity, and while the fruit is much larger, it contains a superabundance of moisture which, after being picked, if the fruit is not properly treated, becomes sour; while those grown on lands suitable for fig culture and of higher altitude, possess much better keeping qualities, contain much more saccharine matter, remain more moist without souring, and in every respect are much better figs. In drying, these show about as follows: The figs grown on low, wet lands become coarse, with less pulp and much tougher skin; those grown in a higher altitude and on valley lands suitable for fig culture are generally not as large, but the grain is much finer, the skin much thinner, the fruit contains much more saccharine matter, and when dried do not resemble the fig of the same variety grown in unfavorable conditions on low, wet lands, excepting in some of its botanical characteristics. Those grown on low, wet lands are generally lacking in flavor and are unpalatable, and appear in many instances as if part of the inside had been squeezed out, while those grown under better conditions are very fleshy, so much so that when pressed they burst out at the end; while the former in being pressed show but little inside and the skin seldom bursts.

There is such a confusion is the nomenclature of the fig that for the present I shall not mention any variety but the White Adriatic (Cal.), this being to-day the best fig in California, as far as we know, for drying.

During the past few years a great many fig trees and cuttings of many varieties have been imported into this State. After they began fruiting, nurserymen and others, having become confused as to their origin or names, at once rechristened them, giving them popular names. In one instance, I found a fig known, within a radius of a few miles, under at least seven different names, and no nurseryman had taken the pains to investigate its true name. I also found, upon investigation, that the same confusion existed abroad. The Minister of Agriculture for Italy found this same difficulty, and was unable, in his own province, to identify more than three varieties; yet, in that same district, more than one hundred varieties had been previously described by nurserymen and others.

The same confusion was found in the names of the fig tree and cuttings imported from France. Trees were once received from a district in France under certain names, and from that same district trees were received under entirely different names. Those varieties most prominent, however, although not more than a dozen, could be traced by following the California popular names that had been given them; but this would hardly be of any use, except for identification, a subject I expect to treat in a subsequent publication.

Conditions in this State are so varied that, as I have stated before, figs grown in different localities change their characteristics so much as to prevent identification, unless by an expert in that line. In one of the valleys I found the White Adriatic (Cal.) grown under, what seemed to me, perfect conditions. The fruit was the largest of that variety I had ever seen, but the color differed so much that not until I made a critical examination did I become convinced that it was the White Adriatic. The seams on the surface had opened very wide, and, instead of the fruit possessing a light yellowish-green tint on its surface, it was as green as the leaves themselves. There had been several boxes of figs picked that were dead ripe—that is, they had wilted on the trees—yet among those boxes not a fig was found to contain any yellowish color whatever; everything was of a deep green color, yet all the figs were dead ripe. This, however, was a singular thing, and nowhere else had I ever seen this strange occurrence. Possibly it may have been due to certain climatic influences, or the forcing by irrigation. When such figs are processed, they do not become as nice as those which assume a yellowish tint, unless subjected to a strong sulphur bath, which generally deteriorates the quality of the fruit.

In the coast counties the fig ripens much later than in the interior valleys, generally commencing to ripen when those in the interior valleys are nearly or about gone.

THE PROCESSES.

There are two processes which I think can be put to use by the fruit grower, and such as make good and marketable fruit. The greatest care must be taken in the preparation of the fig, as any neglect will cause the loss of a great deal of fruit.

First Process.—The figs are allowed to shrivel on the trees, then they are picked and placed on trays, bloom end down. The trays used are made of slats to allow ventilation from the bottom. The fruit is generally cut with a sharp knife or shears, but a man, after having worked awhile, can pick the figs without the aid of a knife or shears, by a simple twist of the fingers. The trays having been filled are placed in the smokehouse. These smokehouses should not be too large, and neither should the trays, for it is difficult to handle such heavy fruit, and this also prevents bruising. After the trays have been placed in the smokehouse the door is shut, and the sulphur lighted and allowed to burn. The greatest care must be taken in the amount of sulphur that is burned, for if too much is used the figs will have a smoky taste; if not enough is burned the figs will not become entirely bleached, and when dried will not possess that light color so much desired, but will retain part of the greenish tint, especially the part that rested on the trays. The sulphur should be burned at least two feet below the lower tray.

There is great diversity of opinion as to the length of time the fruit should be left in the sulphur box, or smokehouse, and also as to how long the mass of sulphur ignited under it, which produces the fumes, should remain burning.

Fruit cannot be well sulphured or fumed in less than twenty minutes from the time it is placed in the box, as at least ten minutes is required for a mass of sulphur to generate enough fumes, or smoke, to entirely fill every space of the smokehouse. However, after the box or house is filled with fumes, ten minutes longer is enough time for the fumes to accomplish their effect; it could do no further good if the fruit should be allowed to remain a longer time. The object, therefore, in leaving the fruit in the sulphur bath a longer time, is for the purpose of allowing the fruit to undergo an artificial sweat, to reduce the skin, which is done by the heat generated by the inclosed fumes. This is a great advantage, for after the fruit has gone through this artificial sweat and been placed in the sun, the skin is reduced to a minimum, and the fruit turned somewhat transparent.

The sulphur must not be burned too near the fruit, as considerable pure sulphur is liberated, and the bottoms of the trays being open, considerable fruit would be damaged by coming in contact with the liberated sulphur. The fruit on the lower tray instead of bleaching out white will become of a pinkish color and will not dry. Such fruit generally remains in the sun puffed up, seemingly full of air. The reason for this is that the fumes of the sulphur are heavy, and take with them considerable pure sulphur, which is liberated and is deposited on the fruit.

It is impossible to determine the exact amount of sulphur to be used. After the room is well filled with smoke, which can be seen through the trap-door, it is about time to withdraw the sulphur pan. The smoke or fumes are not allowed to escape, but the fruit is allowed to remain in this bath for at least one hour.

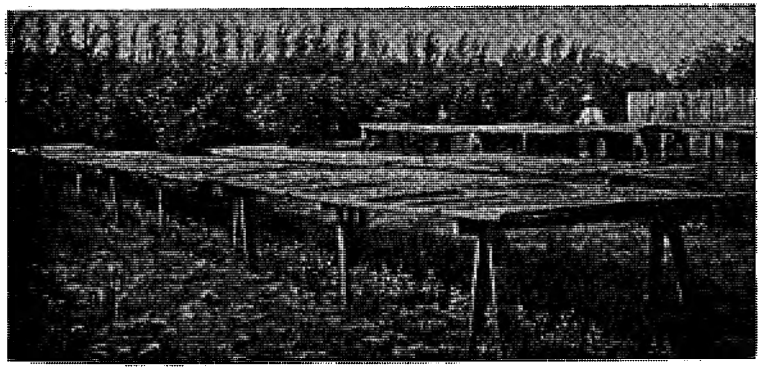


FIG DRYING, SHOWING ARRANGEMENT OF TRAYS.

I find it best to pick the fruit in the morning, for after it has been placed in the smokehouse and once been subjected to the sulphur fumes, it may be placed in the sun, where it bleaches out beautifully, much better than it would later in the afternoon, as the hot rays of the sun are an advantage. The fruit picked and sulphured in the afternoon, by the time it is placed in the sun the sun will be so weak that the fruit will not bleach out as well. Those placed out in the morning make a much better fruit, pliable, soft, and the skin is reduced considerably. After the fruit has been exposed to the sun for an hour it is turned over by hand. This is done to allow the part resting on the trays to also become bleached, as that part will retain its original color if not turned over.

After the fruit has been out a day it is time to handle it, that is, the fruit can be rolled between the fingers, which is called in many instances "fig pulling" or "rolling." This is done to prevent the figs getting hard in drying. The operation can be performed every day if the operator so chooses, but it is not necessary unless the figs have dried considerably. After the figs have been out at least four days, have dried away considerably, and have been turned over and rolled between the fingers from time to time, as above stated, they can be removed from the sun and placed in the shade. This prevents the fruit from getting hard.

After all signs of moisture on the surface have disappeared, the fruit is placed in wire baskets and dipped into boiling-hot water—the hotter the better. This dipping closes up the pores, kills all germs, and again reduces the skin somewhat, and gives the fruit a beautiful color. It is only necessary to dip the fruit into the water and raise it up immediately, two or three times. If allowed to remain too long in the water it will be rendered sour and a great deal of the true fig flavor will thus be lost, which must then be substituted by other means or the article will be inferior.

After the dipping the water is allowed to entirely drain off from the figs and they are then thrown into a pile, either on a clean wooden floor, or table, or bins, and from time to time are shoveled backwards and forwards until they become cold. When the moisture has entirely evaporated it is then time to pack them.

It will be observed that in processing figs in this way there will be two or three grades of fruit, at least two; the first of the light pinkish color, and the second a much darker color. They should then be assorted and the grades packed separately. The reason for this variation in color is the unevenness in the drying of the figs on the tree. Generally in picking it is impossible to have the fruit of about the same degree of ripeness. That which has shriveled considerably will not become as light in color as the fruit that is less shriveled; in fact, the fruit that has not shriveled at all becomes the best color. The culls are assorted and the best fruit put into boxes in layers, not artistically arranged, but simply thrown in, and between the layers fine white granulated sugar is dusted and then the boxes put under heavy pressure. The sugar serves to cover up many defects in the fruit. These, after being packed a few weeks, become a good marketable article, which of course does not bring as much as the two grades above mentioned. The fruit that cannot be used in packing, that is, the discarded culls, is placed in barrels or sacks, and can be sold as hog feed and for the purpose of making vinegar, to which purpose they are well suited.

Second Process.—The fruit is picked from the tree when it has shriveled considerably, and is placed on trays without sulphuring. The trays are made of slats and placed on staging, which should be sufficiently high from the ground to allow a free circulation of air beneath the trays. It is best to place the bloom end of the fruit towards the rising sun, as that part requires more heat than the stem end. After the bloom end has dried, the stem end, containing very little moisture, will dry with less heat. This, however, can be done without much handling, as the figs, having been set all one way, and as the sun in the afternoon changes to the west side, the tray is simply turned around instead of the fruit. This brings the end of the fruit in direct contact with the sun during the hours of drying. After the fruit has been out for at least two days, "finger pulling" or "rolling" begins. The figs are rolled between the fingers and turned over on the trays. This operation can be performed as much as the operator pleases without injury to the fruit.

After the fruit is dried it is placed in boxes in the storehouse; the boxes need not be filled to the top, and can be piled one on another. They are kept in these boxes for at least six or eight days, to allow them to undergo a natural sweat. Every day, however, they are emptied from one box into another to allow the part resting on the bottom to become on the surface; in this way they never become moldy.

After the moisture among the figs has disappeared they are ready for packing. They can then be assorted into as many grades as the operator chooses; however, it is unnecessary to pack more than three grades, and seldom more than two.

Before packing, the figs are dipped into a solution of hot water containing a little glycerine or glucose. This will serve to give the fruit a gloss which it does not possess before dipping. Bay leaves are placed amongst the figs in packing in the boxes, which serve to give the fruit an attractive appearance. It is claimed they keep away insects, but such is not the case.

USE OF SULPHUR.

Communications have, from time to time, been received asking for a description of what I have claimed "sulphur bath" or "sulphuring;" some going as far as to ask if the sulphur is made into a solution, and the fruit dipped into it. In terming the "sulphur bath" or "sulphuring," I had reason to believe that the term would not be misconstrued, as most fruit growers know its meaning.

Sulphur is used, and properly should be called "bleaching," as it bleaches the fruit. It is only the outer surface of the fruit that is exposed to the sulphurous fumes. These fumes deoxidize any germs that are attached to it, or produced right on the fruit. There is no solution used, and I am astonished at the questions propounded.

The only chemical action of the sulphur fumes is to bleach the fruit on the very exterior surface; it does not bleach, or even enter, the interior surface, as the fig, whether or not it be opened at the bloom end, is generally full of air, which prevents the sulphur fumes from entering, and even if it did it could do no damage. The sulphur fumes only determine the color of the dried fruits, and sulphur is used simply to stop discoloration of the outside and brighten the fruit.

The common method of burning sulphur under fruit and leaving it burn for a considerable length of time, to render the fruit transparent and of a light color, rather tends to detract from its true flavor, than to add to its improvement. Fruit should only be confined in sulphur fumes with the objects above stated. Figs are not cooked for eating, and differ in this respect from other fruits; therefore, the process should be one to retain that flavor so essential in a marketable article for consumption in a raw state.

The best method I know of for generating sulphur fumes, in the least time, consists in placing a heavy one and one half or two-inch iron plate on a small kerosene stove in the smokehouse. When this iron plate becomes hot, but not so hot as to cause the sulphur to flame, the fire is extinguished (turned off), and the sulphur spread on the iron plate. As soon as the sulphur comes in contact with the plate a dense smoke is liberated, which fills the smokehouse in a few minutes, and in much less time than when ignited. It has also the advantage that gases and sulphur are not liberated and deposited on the fruit as when allowed to burn.

XVII.

PROPAGATION.

The propagation of the fig is very simple and can be multiplied in various ways, viz.: By suckers (shoots that spring from the roots), by layers, and by cuttings.

Suckers.—The young shoots that spring up from near the base or crown of the tree are called suckers. They generally contain a small portion of roots, which upon being transplanted soon form trees. The wound made on them by removing from the parent tree soon heals over. There are, however, great objections to trees produced from suckers. First among all is, perhaps, the fact that as the sucker generally contains a portion of bark from the parent tree, from which many shoots or suckers put forth; also the growth is not well formed, resembling water sprouts, having but a feeble body, and as they are required to be topped in order to branch out, put forth feeble shoots which the body of the tree cannot support. In such cases it is best to allow such trees to grow the first year without trimming to form their body, and the second year the trees can be pruned as desired; in this way they become more healthful.

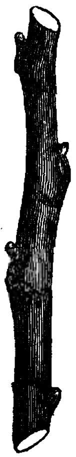


Figure 27.

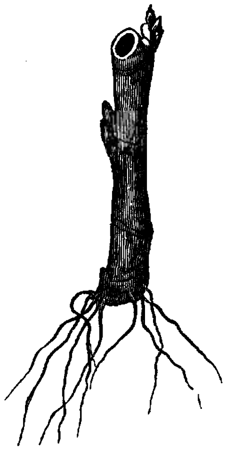


Figure 28.

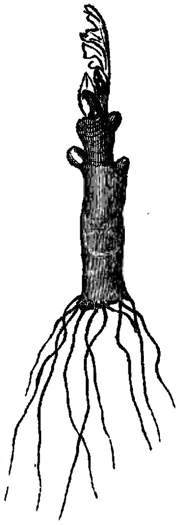


Figure 29.

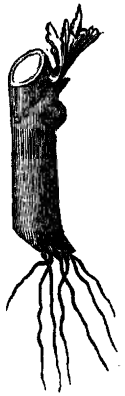


Figure 30.

Cuttings.—There is no better way to propagate the fig than by the simple method of *cuttings*, which is the most practical, and above all the best. By this method nearly every part of a tree can be utilized. The best months for the propagation of the fig by cuttings is through the months of February and March, the cuttings at this time being taken off while the trees are quite dormant. Great care must be taken that no cuttings be cut after the sap is in motion, because the milky juice which is produced so abundantly prevents the rooting of the cuttings. This, however, has no reference to young shoots in summer, which towards autumn, when the wood is ripening, root very readily.

The illustrations (Figures 27, 28, 29, and 30) show the selection and preparation of cuttings. Figure 29 represents a cutting made from the end of a shoot, showing the formation of roots. Figure 30 represents a single eye cutting. Figure 28 represents a large cutting, six to eight inches long. Figure 27 represents a large cutting as it should be prepared, six to eight inches long, containing four eyes. The upper cut is made at least a half inch above the eye, which is a protection to it, as the ends generally die back. All reduced in size for illustrating. The best cuttings are from stubby, short jointed, well ripened wood; they grow the most readily. One year old wood is generally the best age for cuttings, although two and three-year old wood also does remarkably well, though no eyes may be visible. The long spindling, badly ripened shoots, like water sprouts, suckers, and such as are produced where the wood is crowded, are very difficult to make grow, and those that do grow require age to become thrifty trees.

Pruning.—Pruning should be performed as soon after the fall of the leaves as possible, in whatever situations the trees may be. When trees are pruned at that season, they being then dormant, no injury is sustained; while, if the operation is delayed until late in spring, when the sap is again in motion, and there being such a volume flowing, that in that nature the shoots are apt to die after being cut. The success of the fruit crop greatly depends upon the method of pruning.

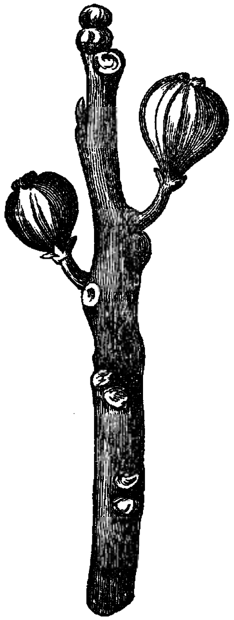


Figure 31.

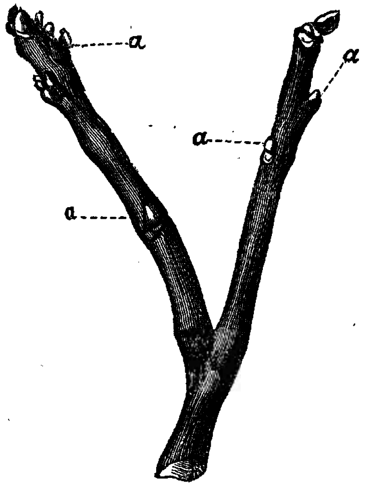


Figure 32.

It has often been claimed that the fig tree never bears when once pruned; this is, to a certain extent, correct, but the real cause is entirely owing to immaturity of the wood, caused by pruning, which fails to produce fruit, or to the fruits being produced and failing to ripen, as shown in Figure 31. If the fruit-bearing shoots (Figure 32) are cut back the first crop of fruit is destroyed.

Fig trees having non-bearing shoots, as shown in Figure 33, can be pruned without any loss of fruit. If a fig tree is pruned to any extent, there will be a loss of the crop; however, such operations at times must be performed to keep the trees well balanced and within form, although this only affects the crop of one season. After the tree has been properly balanced and shaped, whether high or low, then pruning can be effected the following year with a certainty of a crop the same season; in such case the shoots, as represented in Figure 32, must not be cut, excepting just a few here and there to keep the tree well balanced.

All such shoots which bear only wood buds, as shown in Figure 33, should be cut back, and, if necessary, cut out entirely, as they only take away nutritious sap which should flow into the fruit and into fruit-bearing wood. Branches of almost any age or size can be cut off from any part of the tree, and young shoots will be produced quite freely, as shown in Figure 34, but the cuts or wounds should always be covered with grafting wax or rubber paint, which helps them to heal over, and protects the stock from the action of the atmosphere. If too many shoots are thus produced, they can be reduced when young to the required number.

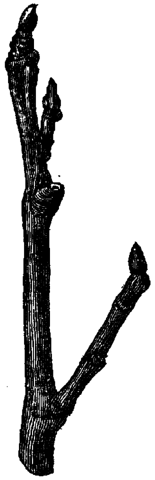


Figure 33.

FORMATION OF THE TREE.

The proper formation of the tree next presents itself for consideration, with a view to the simple production of fruit. In the formation of the tree with such a view requires the exercise of knowledge and understanding. All fruit trees which naturally assume a bushy form should have their energies confined to a single stem, with the head of the tree of whatever character formed thereon, and they always prove the most fruitful. When a number of shoots are allowed to spring from the root, all striving to outstrip one another, a huge, unshapely bush is the result. Fig trees, as a rule, produce suckers (shoots from the roots) in abundance, which, even if they have a fine, healthy appearance, should not be allowed to remain; they produce no fruit and only crowd up and rob the parent stem. The confining of the plant to a single stem is of the utmost importance for the production of fruit of nearly all fruit trees, and is especially so with the fig.

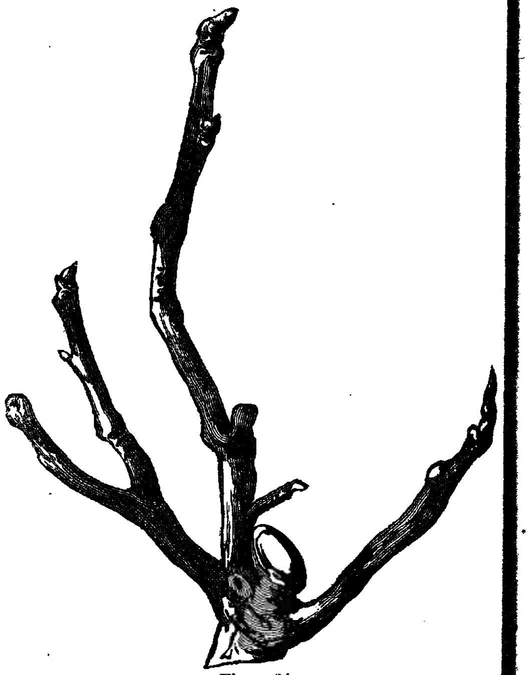


Figure 34.

The trees can be trained either with high or low trunks, after once being formed; pruning then becomes less, requiring only thinning out and occasional shortening of some of the branches. The pruner has, however, great difficulty in contending against the over luxuriance of growth of trees grown on damp soil. In such cases, it is necessary that the pruner should guard against over luxuriance, by keeping the shoots on the tree thin and well exposed to the full influence of the direct rays of the sun. The trees should also be prevented from extending beyond bounds, even if heavy cutting has to be resorted to. Where trees grow under such conditions (too luxuriantly) the young growing shoots should be vigorously pinched back through the summer, in order to check luxuriance and bring the tree into a stubby, fruitful form of growth.

PRODUCTION OF FRUIT.

The first crop of the fig is borne on the wood of the previous season's formation, as represented in Figure 32. The young embryo fruit being shown at *a*. That of the second or succeeding crop is produced in the axils of the leaves on the wood of the current season's formation. Figure 31 represents the remnant of the last crop of fruit of the previous season as they are to be seen frequently on the trees after the fall of the leaves in autumn. They are the late fruit of the past season which failed to arrive at maturity, perhaps through want of heat or the proper conditions required at that time. This fruit is not worth consideration; sometimes a few, under very favorable conditions, remain on the tree and ripen, but this, however, is very seldom. Figure 33 represents a shoot having no fruit buds upon it, only wood buds.

These three figures represent the different characters of shoots, with the position of the fruits, buds, etc., as they are commonly seen on fig trees in the dormant period, during winter time. When a tree ripens its wood in its best conditions, healthy shoots, as shown in Figure 32, are found most plentiful; on the contrary, when a fig tree is grown under conditions unfavorable to its culture, such feeble growth or shoots, as shown in Figure 33, will predominate.

A SIX-YEAR OLD WHITE ADRIATIC (CAL.) FIG ORCHARD.

XVIII.

SETTING OF THE FRUIT.

It has often been claimed that "the fig in this State does not set, that caprification is absolutely necessary, that the seeds having no kernels fully establish this fact." If caprification is absolutely necessary, this question arises: "Why do figs produce and set their fruit as well as they do in this State without it?" No fruit can set without the flower be first fertilized; therefore, if our figs set their fruit, it is by the fertilization they receive from the pollen of the flowers; if there be no pollen to fertilize the female flowers, no fruit could set.

In the fig the organs of fructification are hidden from view, therefore we cannot tell exactly when fertilization is effected, but it is supposed that it takes place when the eye assumes a pinkish hue and expands and admits a little air into the interior, where the flowers are.

In many parts of Italy and the south of Europe, in olden times cultivators paid much attention to setting the figs by the method of caprification. This practice was much believed in, but is condemned by most modern scientific writers as absurd.

Caprification, according to the experience of practical growers, is altogether a delusion, and many of the largest plantations of the old world have continued to bear fruit without the aid of the caprifig.

Professor Gasparrini, a learned botanist, carried on very extended experiments, covering a period of six years, and in an essay written for the Royal Academy of Sciences of Naples, detailed the number of experiments which he had made and repeated in different years. Their results lead to the conclusion that caprification is useless for the setting and ripening of the fruit, and that instead of making the figs remain on the tree, it either causes or facilitates their fall, especially when the insect had penetrated into the inside and produced decay by its own death. When the insect ever entered a fig, the maturity of it was hastened, as apples and pears are when attacked by a grub. Professor Gasparrini recommended the abolishment of the practice, as it only entails expense and deteriorates the flavor of the fig.

In the islands of the Archipelago the practice has been abandoned, according to the French naturalist, Oliver, but in which islands excellent figs are produced.

The process, stripped of all its mystification, is a simple one, which, as stated before, has proved a delusion, and is only alluded to here as such. In the first place, there is a wild species of fig, called caprifig, on which it is said a certain insect exists, which enters the fruit when in the young state, at the eye, thereby facilitating the entrance of light and air, or some fertilizing vapor whereby the flowers are enabled to set and ripen. In fig plantations numbers of this wild species are planted for the sole purpose of bearing these insects, and at the proper season the fruits with the insects are carried and deposited on the fruit or shoots of the domestic species. There are in southern France fig trees called *caprifiguiers*, which bear the insect.

Without all this maneuvering it is faithfully believed that very scanty crops of figs would be secured, but according to the investigations of modern science, it is proved to be not only unnecessary but positively injurious.

XIX.

THE WALNUT.

BUDDING THE WALNUT.

The walnut is budded very successfully by the following method: The bud is cut (as shown in Figure 35) about one and one ha inches long. The cut is made deep into the wood, the object being to give the bud as much bark as possible. The wood in the bud is then partly removed; it is gouged out with the sharp point of the budding knife. This is done to allow the inner bark of the bud to unite with the inner bark of the stock, which union would be prevented if the wood should be allowed to remain in the bud. After the wood in the bud has been partly removed (as shown in the illustration), the bud is inserted into the cut made in the stock, the same as ordinary budding is done. The bud must be tied tight with heavy budding twine. Three weeks after the bud has been inserted, the twine is removed and the bud allowed to lay dormant until spring. The walnut does not put forth until late in the spring, therefore the stocks are not cut back until then. As soon as the buds begin to swell, the stocks are cut back, and the buds allowed to grow. Great care must be exercised in not cutting the stocks so close to the bud as to endanger it. The buds are allowed to grow at will until they become hardy, then they are trained to the stock, the object in view being a straight tree. After the buds have made a year's growth, they can be transplanted into orchard form.

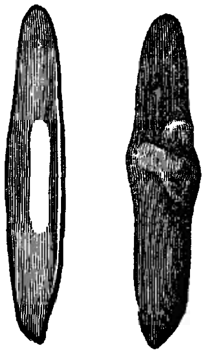


Figure 35.

GRAFTING THE WALNUT.

Grafting walnuts is not as easily performed as budding. Great care must be exercised in the manner in which the operation be performed. The walnut cannot very well be grafted successfully by the ordinary method practiced on fruit trees. The reason is that the scions contain but very little wood, as the pith is very much larger than in other trees, and when the scion is cut (wedge-shape) very little wood is left to it, mostly bark, and if inserted cannot unite with the stock, not being held firmly in position. Side-grafting, however, can be accomplished with success. About twelve years ago I grafted many walnuts in this way very successfully, but it can only be performed in the spring, when the sap in the stock begins to rise; this is necessary, as the graft must be inserted in the same manner as a bud. The walnut does not put forth until quite late in the spring, therefore it is necessary that the scions be gathered before the trees start, and be prevented from starting by being kept in a cool place covered over with moist sand; in this way they can be kept until the stocks have made sufficient growth so as to facilitate grafting.

The most satisfactory method with me has been the "Prong method" (original). In this method the prongs found at the extremity of the branches are used. Figure 36 illustrates the scion, or prongs, used, and the method of cutting them from the branch, reduced in size for illustrating. The prong is cut as illustrated, and the wood in the prong (graft) is removed with the point of the budding knife, the same as in the method previously described, and as shown in Figure 38. The stock is then cut off with a sharp saw, and smoothed over with the knife and the graft inserted as shown in Figure 37, and tied tight; no less than eighteen-ply twine should be used. The cuts are waxed over with grafting wax. After the grafts have started, they should be examined, and if the twine is found to begin to cut into the stock, it is untied and tied over again; this will prevent further injury. The object of allowing the twine to remain a longer time is to prevent the cut bark from opening by the action of the atmosphere and causing the grafts to die. I grafted several years ago, many walnuts in this way with very good success. I also grafted the English walnut on the wild California walnut, found growing in the mountains, and on the black walnut, and the results were indeed very satisfactory.

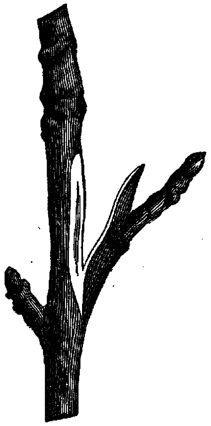


Figure 36.

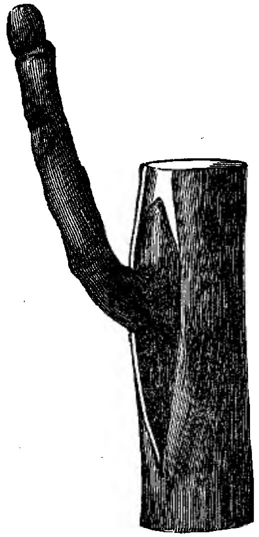


Figure 37.

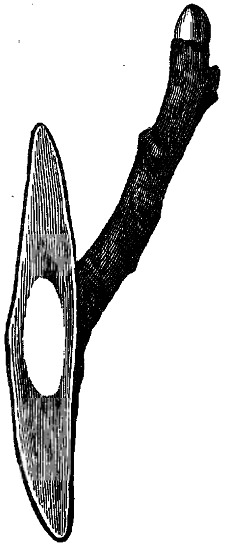


Figure 38.

XX.

STRAWBERRY TREE.

ARBUTUS UNEDO.

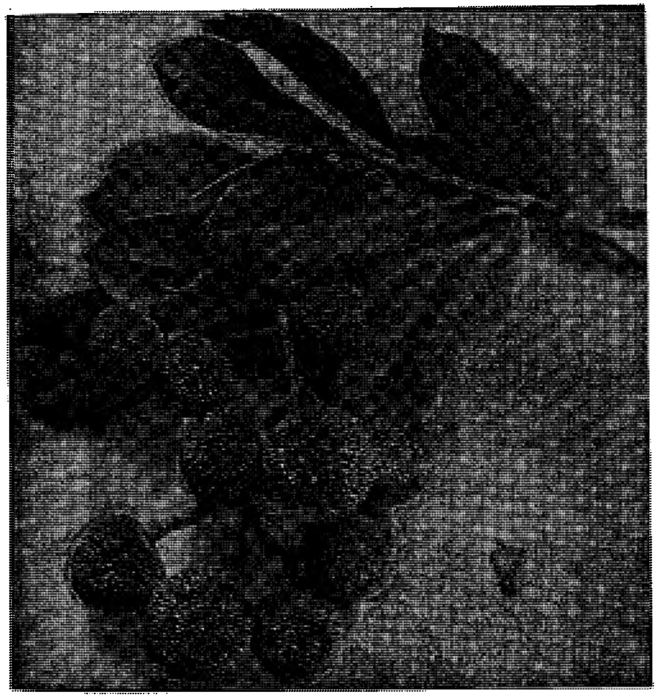


Figure 39.

This beautiful evergreen shrub thrives exceedingly well in our State. Commissioner Mosher has, at his place in San José, two large trees, which are the oldest in the State. The foliage resembles the foliage of the madron, but the leaf is much smaller. The fruit ripens in about December, and is of a deep vermilion red, and carries on its surface spines, quite visible and prominent. The bloom is white and forms in clusters; the scent is sweet and very fragrant. Dr. Rhindy describes the *Arbutus unedo* as a hardy and elegant looking evergreen. The leaves, oblong, lanceolate, and serrated at the edges, the bell-shaped flowers forming a depending panicle, and the ripe berries, both of which are in profusion together in the end of autumn, render this shrub very ornamental at that season. It is a native of south Europe, and is also found in a wild state in Ireland, where it was probably taken originally from Spain or Italy. It, however, flourishes there in a calcareous soil in greater luxuriance than is often to be met with in the woods of Italy. In both countries the fruit is eaten, and in Spain both sugar and spirit are extracted from it.

There are three varieties of the species—the red flowered, double flowered, and the entire leaved. Two of these varieties are now fruiting in this State. They differ in general appearance but little, and the same may be said of the fruit, but the fruit of one ripens through the summer, and the fruit of this one through the winter.

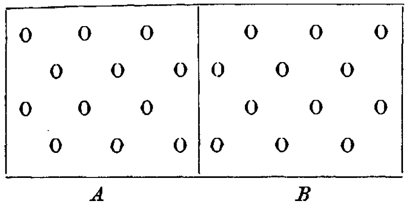
The fruit has an excellent taste, having the true strawberry flavor. The tree blooms when the fruit is about ripe, the beautiful white, sweet-scented flowers, and the elegant looking deep vermilion red fruits, form a contrast not often seen in the garden or orchard. The tree is easily grown, and should be more cultivated.

XXI.

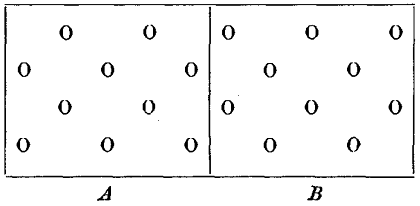
PACKING ORANGES.

The importance of packing and grading all kinds of fruits, and especially that of oranges, has become what you might call a "fine art."

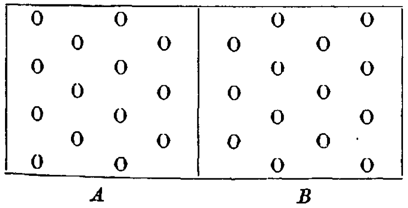
The following plan has been published by us before, but it has remained for the "Florida Agriculturist" of Deland, Fla., to illustrate it so that any one can readily understand the *modus operandi*. All the important grades are here given:



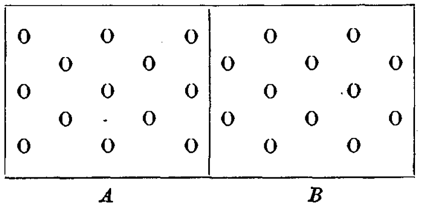
1. Packing 96 to the box; four layers, alternating, as in A (first layer) and B (second layer).



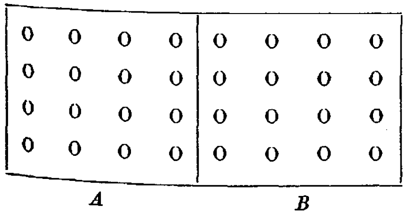
2. Packing 100 to the box; five layers, alternating, as in A (first layer) and B (second layer).



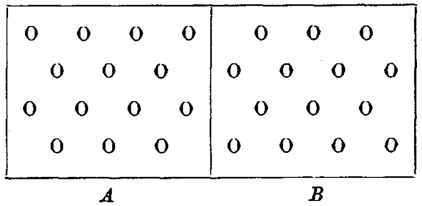
3. Packing 112 to the box; four layers, alternating, as in A (first layer) and B (second layer).



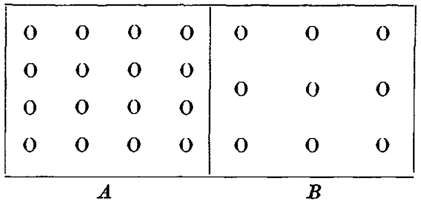
4. Packing 126 to the box; five layers, alternating, as in A (first layer) and B (second layer).



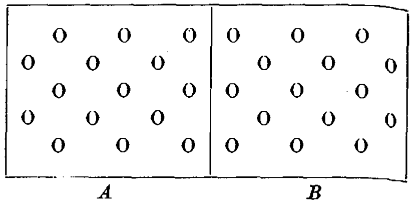
5. Packing 128 to the box; four uniform layers.



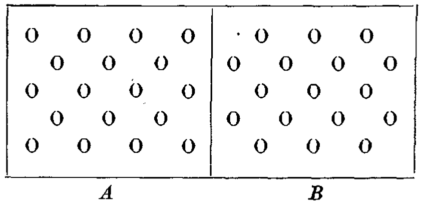
6. Packing 140 to the box; five layers, alternating, as in A (first layer) and B (second layer).



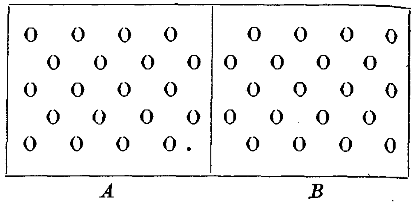
7. Packing 146 to the box; four layers as in A, and one layer (the second) as in B.



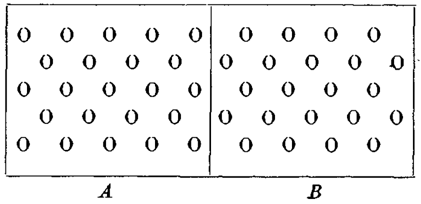
8. Packing 150 to the box; five layers, alternating, as in A (first layer) and B (second layer).



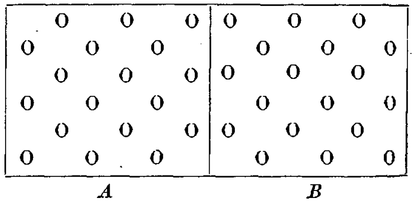
9. Packing 176 to the box; first, third, and fifth layers as in A, and second and fourth layers as in B.



10. Packing 280 to the box; five layers, alternating, as in A (first layer) and B (second layer).



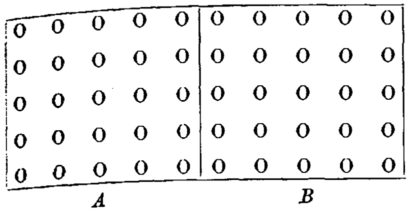
11. Packing 226 to the box; five layers, alternating, as in A (first layer) and B (second layer).



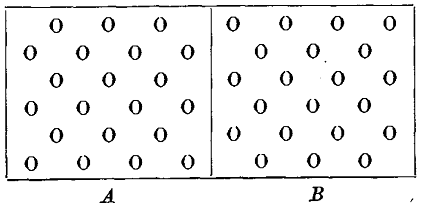
Six layers, 18 in a layer. A, first layer; B, second layer.
The 226 size will pack this size nicely; it is 216, and packed as shown.

The 226 size is the hardest size to pack, for a row with five oranges in it has to be squeezed all out of shape to get them in, to say nothing of bruising the fruit. There is none of this with the 216 method; each goes in a place for it, and stays there.

In packing, it will be to the best advantage to have the end of the box toward the packer, and commence a box of 100, 126, 150, 176, and 200, with 3 in the first row, 2 in the next, and so on, until you have one layer; then there is a place for each orange. The 112 size goes 4 and 3 in a row, the 216 size 3 and 3 in a row, the 252 size 4 and 3 in a row (a smaller size may be packed—the 294 size—same as the 252 size, putting in one more layer). There should be a size smaller than the 252 size in the sizer to keep the small oranges out, for, if the small ones go in the 252 size, they will not pack tight enough.



12. Packing 250 to the box; five uniform layers.



13. Packing 252 to the box; six layers, alternating, as in A (first layer) and B (second layer).

The arrangement which brings one orange directly on top of another as in the 128, 146, and 250 sizes (Diagrams 5, 7, and 12), instead of breaking joints as in the other plans of layering shown, have been discarded by the best packers. Alternated so that each orange comes over the space between two, the whole has more solidity and elasticity, and the fruit, as a result, sustains less injury from rough handling. It is best to pack oranges upon the dove-tail plan, which enables us to get more oranges in the box and so braced against each other as to be immovable.

Regulate the size so as to have the oranges packed in tight and rise a full half inch above the top of the box. Have the lever so constructed as to press the top square and solidly down, and they will never move in box.

We advise packers also to discard the 96, 112, and 140 sizes, as unnecessary and superfluous, confining themselves to the 100, 126, 150, 176, 200, 226, and 252 sizes. If the sizer be properly adjusted, this will provide for all sizes and simplify matters very much. An experienced packer says: "I do not put up any of the 112 count. I take the 128 size and put in one layer as if packing 126 size. Then a layer of 112 size just the same, alternating the sizes until full, which makes a box of 126. This method is shown in Diagram 4. The left hand end shows the first layer of thirteen; the right hand end shows the second layer of twelve, alternating or 'breaking joints' with the fruit; next comes another layer of thirteen and so on, three rows of thirteen and two of twelve filling one end with 63 oranges. This packs '3¼' oranges straight, but I take the 128 size and the larger sizes of 112, etc., and pack 126. This sells better than the 112 size; 100 size will take the place of 96 and 112, and is packed 3 and 2 in rows, 10 in a layer, five layers in a box. One great point in packing is to break joints so that one orange does not rest directly on top of another. The 150 size has taken the place of the 140 and 146, and is packed 3 and 2 in rows in first layer and 2 and 3 in rows in second layer, 15 in each layer, and five layers in each end."

Oranges should be *cut from the stem*, not *pulled*. Before packing, the fruit should be *thoroughly dried*.

Use only the *Standard Box*, which measures 12x12x27 inches, with partition in the center. The boxes should be securely hooped at both ends and also in the center. The hoops add to the strength of the package, besides being a valuable aid to ventilation.

Do not dump the fruit into the boxes carelessly. *Pack close and firm, so that the fruit will not have room to tumble about in the boxes and get bruised.*

Oranges classed as fancy should be extra bright, with very smooth, thin skin. Rough, thick skinned fruit, being ever so bright, should never be classed as fancy.

Oranges classed as choice bright should be strictly bright and fairly smooth skin and of desirable size.

Oranges classed as bright should be bright and free from smut.

Never pack bright and smutty oranges in the same box. Never pack large and small oranges in the same box.

One of the most important features in the packing of oranges is the uniform neatness of the packages. Buyers will pay more for fruit that is neatly and properly packed than they will pay for such as is carelessly put up. A box of oranges neatly packed, strapped, and marked naturally attracts the attention of buyers.

In the upper left hand corner of the box-head stencil the quality of orange the box contains—*Fancy, Choice Bright, Bright, Mandarin, Tangierine*, or *Navel*, as the case may be.

In the *upper middle* of the box-head stencil the number of oranges the box contains—"128," "176," "200," etc., as the case may be.

In the upper *right hand* corner stencil the *letters* according to the following schedule:

All sizes under 128, mark A.
Sizes 128 to 138, mark B.
Sizes 146 to 160, mark C.
Sizes 176 to 200, mark D.
All sizes over 200, mark E.

In explanation of above, we will state that, owing to the enormous proportions our crop of oranges is assuming, we find it absolutely necessary that a system be adopted which will, in a measure, condense the almost innumerable sizes into a smaller space, thereby enabling dealers and buyers alike to handle the fruit more expeditiously.

It will be borne in mind that under this new method the identity of the contents of the box is not lost, as the number of oranges in the box is to appear on same, in addition to the lettering, as explained above.

In shipping Mandarins and Tangierines, pack the fruit in *half boxes.* Many growers cut the standard box in half, *lengthwise*; then strap the two halves together, when packed. Some growers obtain very fancy prices for their Mandarins and Tangierines, while many others, having the same grade of fruit, fail to secure more than is being realized on ordinary fruit. The difference is all due to the style of packing and packages. Shippers securing fancy prices take especial pains in the selection and packing of their fruit. Unless extra care is exercised in the putting up of this fruit, you cannot expect to receive fancy prices.

All growers should endeavor to avoid, as far as possible, the shipment of green and imperfect fruit. A few years ago the "windfalls" and "culls" brought paying prices, for the simple reason that there was, comparatively speaking, only a limited quantity of this grade of fruit. We must remember, however, that of late years the crop has steadily increased, and the supply of *strictly good fruit* is now becoming amply sufficient to fill ordinary demands; hence, the shipment of *thousands of boxes of "drops," "culls," and inferior fruit* simply aids in depressing markets, and interferes seriously with the sale of good fruit. The shipment of inferior fruit is neither profitable to the grower nor creditable to the State.

XXII.

THE LEMON IN SICILY.

In all the species and varieties of the genus *Citrus*, the lemon is the only fruit that presents, in the most striking degree, the marked peculiarity of producing, at the various seasons, fruit of various sizes and names. Generally speaking, these differences can be classed under two heads, the true lemons and the bastard or untrue lemons.

The true lemons are those that are produced by the normal flowering of the tree, that is, during the months of April and May.

The bastard results from the irregular flowering, and fertilization of the flower, generally caused by unusual rainfall or sudden changes of temperature during the months of February, March, June, July, and following months.

The Mediterranean growers divide the crop into the new or ordinary, the first class, and the bastard crops. The first class crop, the Marziols and Mainlins, produced respectively from March and May blooming, are described as follows:

The general shape is orbicular, with large plain base. The outside surface (epicarp) is various as to smoothness, and the oil cells are sometimes very prominent, other times hardly discernable. These lemons ripen inside of nine months, and if left on the tree for a longer period, are exposed to fall on account of excessive maturity.

The bastard can be detected by its spherical shape, the sections are hard, rich in acid, and deprived of seeds. The juice of the rind is much less acid than the normal fruit. Contrary to the true lemon, the bastard sometimes remains on the tree for from twelve to seventeen months, as it resists all changes of temperature accompanying the turn of the seasons, and is also proof against the attacks of all parasites. They are mostly used for the making of concentrated juice, sherbet, and some for medicinal uses.

COMMERCIAL CLASSIFICATION OF LEMONS—SICILY METHOD.

A great deal of attention is given to the classification of the lemon. Certain sizes are agreed upon, and are recognized by growers and merchants in the selling and buying of the crops. The sizes are numbered from 25 to 49; No. 25 designates the largest size and 49 the smallest. These are called the true lemons.

The number or grading is as follows:

Grading Number.	Number of Layers.	Number of Lemons in Each Compartment.	Number of Lemons per Box.
25	4	100	200
30	4	120	240
36	5	180	360
42	5	210	420

No. 49 and smaller sizes are generally classed as bastards.

The largest and smallest sizes, and all lemons classed as bastards, are usually sold to the manufacturer, to be made into citric acids, essential oils, and sherbets.

No. 36 is considered the choicest and best lemon for importation, and is the size usually sent to this country. It is a better keeper and shipper, probably because it is the most natural growth and fully matured. No. 30 is next in commercial value, and is the same in quality and other conditions as No. 36, but it is not so acceptable a size.

Grades Nos. 42 and 25 are the third grade; these are in little demand, and do not bring the price of the second, unless it is when there is a scarcity in the market.

The lemon is considered the more valuable, and really sells for more money than the orange. It is always in demand, to be made into calcium citrate, concentrated juice, etc., as well as for lemonades, sherbets, and medicinal purposes, whilst the orange is only used for eating and culinary purposes. Again, the lemon tree is not so hardy as the orange.

In Messina, the culture of the lemon is extensive, and is preferred to that of the orange. The crop is harvested at four times; the first is gathered from September twentieth to October tenth, and is the most valuable; the second and third crops are gathered from November to January, and the remaining immature product remains on the trees until February or March.

The greatest care is taken in picking the crop to prevent bruising, are stem cut, and are gathered in lined and padded baskets; are assorted and graded, and every defective lemon is rejected.

METHOD OF MAKING CITRIC ACID.

The following is the method used in a large manufactory of England:

The expressed juice of the lemon is first clarified by heating and treating with egg albumen, which precipitates the mucilage and organic matter. After the clarified juice is decanted into a tinned vessel, it is heated nearly to the boiling point and saturated with carbonate of lime. The point of saturation can be determined by adding the powdered chalk in small quantities till effervescence ceases. The amount of chalk is about one pound to sixteen of juice. The effervescence is due to the action of citric acid on the lime, forming citrate of lime and liberating carbonic acid. The citrate of lime is insoluble, but another salt is formed (acid citrate of lime) which is soluble. This is rendered insoluble by the addition of small quantities of a solution of slacked lime, until the liquid ceases to have an acid reaction on blue litmus paper. This citrate is then poured into boiling dilute sulphuric acid which forms a sulphate of lime, and a pure solution of citric acid. This solution is siphoned off into another vessel, the sulphate washed and the washing added to the solution, then all is evaporated in a porcelain or lead vessel till a translucent pellicle is formed on the surface. The liquid is allowed to cool, when the citric acid will crystallize in the form of rhombohedral crystals. After some days the crystals are taken from the liquid, and it is again evaporated, the operation being continued till the crystals are small and unshaped, when it is treated as lemon juice with more fresh juice.

Citric acid thus manufactured as above, is a gray colored substance, containing various coloring matters which may be eliminated by washing with chlohydric acid and water and filtered through boneblack.

XXIII.

TREE PLANTING.

ARRANGEMENT OF THE ORCHARD.

Of all rural occupations it is questionable if there is another which possesses the degree of fascination, or yields the depth of genuine enjoyment equal to tree planting. Crops of annual production and brief existence may afford a passing gratification, but a few months sweep away all trace of our arduous service, and the round must again and again be repeated. In some sort one's life acquires a posthumous lease in the planting of trees, which, whether for ornament or profit, may thrive, continue, and wax great through succeeding generations, affording pleasure to the sight and ministering to material necessities.

In the early development of a new country, orchard planting naturally receives the more prominent attention, and to this department, and chiefly to the deciduous class of tree, the considerations of this article are directed.

Amongst the large number of new orchards planted each year, a considerable proportion are put out by persons who have had no previous experience in this work. With such, and others lacking proper knowledge, mistakes frequently occur, resulting in loss or disadvantage to the planter, and also in regret to the nurseryman, who, if right-minded, naturally wishes the best success of those who favor him with their patronage. In the haste usually attending the engagement and delivery of trees, there is seldom an opportunity to caution the purchaser regarding those details which, in planting, are essential to their future well-doing, and without attention to which even the best of trees cannot be expected to make satisfactory progress.

In view of this difficulty, the following suggestions are put in printed form for the benefit of those who may need advice. It is not possible within the compass of a few columns to present any considerable part of all that varied information which would be useful to the orchardist. It is here intended only to offer some practical hints, based upon well established principles, to serve as a guide in the earlier operations. Other knowledge, equally requisite, should be acquired through further study and observation. A subscription to the leading horticultural or agricultural journal of nearest publication will be money well invested, as thereby the local experience of others is made available, affording valuable aid and often preventing costly mistakes.

It is assumed that careful judgment has been exercised in the selection of ground suitable to the purpose of the planter. In this, depth of soil, fertility, drainage, and protection from prevailing heavy winds are always desirable, and where naturally lacking should, so far as practicable, be artificially supplied by manures, ditches, windbreaks of trees, etc. The question of water supply should not be overlooked; for while there are few places where with thorough cultivation the natural rainfall will not supply sufficient moisture to perfect good fruit in fair quantities, yet, on the other hand, there are few orchards in California so advantageously situated but judicious irrigation will secure an increase in the product, affording more than compensating profit. It is sheer folly to ignore the factor of water in the agriculture of this country.

The proper selection of fruit for an orchard is dependent on considerations so variable as to preclude any uniform rule. For a family orchard, the list should include nearly the entire range of desirable fruits suited to the locality, with varieties succeeding each other from early to late, in order to furnish a supply of fresh fruit through as great a portion of the year as possible. For market, questions of demand, distance of transportation, etc., all have an important bearing. Discrimination is required according to whether dependence is placed on shipping, canning, drying, or household use in the home market; few kinds being equally adapted to all these purposes. A limited number of well chosen varieties will be found more profitable than a large diversity.

WHEN TO PLANT.

For deciduous trees, as a general rule, as early as practicable after the winter rains have come. In this mild climate the roots of a tree do not wholly share in the dormant condition of the buds. If a tree is properly transplated early in the season, and a month later is taken up, it will usually be found to have formed a callous about the ends of the roots where the bruised parts have been trimmed away, and often masses of young rootlets will be seen extending from these and other parts. Early planting favors a thorough settling of the earth about the tree by the action of the winter rains, and by the time the buds begin to swell, the tree has measurably recovered from the shock of transplanting, and with new roots already gathering food from the soil, springs at once into vigorous growth. The late planted tree is more or less enfeebled by the attempt to grow before the roots are sufficiently developed to supply the demand for nutriment made by the expanding leaves. A brief, weak growth follows, often so completely exhausting the vitality of the tree that it is left without strength to resist the severe ordeal of summer heat and drought. Citrus trees are transplanted at various seasons, preference being given to one of its several dormant periods, occurring during the year. May and June is the time most preferred.

PREPARATION OF THE SOIL.

First, and always, let this be thoroughly done. Land which has before been cultivated is preferable. Like the cooking of food for animals, the working of the soil liberates crude gases and changes the nutritive principles to a form more readily assimilated by the plant.

It seems hardly necessary to remark that no manipulation of the soil should be attempted when it is in a wet, adhesive condition, or when so dry that the lumps will not readily pulverize. Any required leveling should be one of the first operations, and a condition of deep, perfect tilth the conclusion of all.

ARRANGEMENT OF THE ORCHARD.

In orchard planting there are three methods in most common use, known by various names, but probably best distinguished by the geometrical forms into which the trees thus planted are grouped, viz.:

Triangular.	Square.	Quincunx.
O	O O	O
		O O O
O O	O O	O

Of these the simplest and most frequently adopted is the square. In this the orchard is laid off in lines crossing each other at right angles with equal intervals of space, and a tree planted at each crossing of the lines. As the roots of a tree are presumed to generally radiate from the trunk and extend an equal distance in all directions, they may be said to occupy a circle of ground. In such a case it is obvious that a disadvantage attends the square system by leaving an unoccupied space midway between each four trees, unless their roots overlap each other at the nearest point of juncture, which, in theory, should not occur. This can be easily illustrated by laying out four coins in a regular position. Now, take three of these coins, place them in the form of a triangle, with their edges touching. Observe the comparative reduction of this waste space, and an idea is given of the superiority of the triangular system. This, of all others, is unquestionably the nearest perfect. Without crowding the trees any closer, it secures 15 per cent more than the square to any given extent of ground. The larger number of persons who plant orchards do not fully appreciate this advantage. Let it be further illustrated: By the square system, at twenty feet apart, one hundred and nine trees are planted to each acre. Assuming their yield at mature age to average two hundred pounds of fruit to the tree, the crop would aggregate twenty-one thousand eight hundred pounds per acre. Planted by the triangular system, this same acre will support equally well one hundred and twenty-six trees, which, at the same estimated yield, would afford a crop of twenty-five thousand two hundred pounds per acre, or an increase of three thousand four hundred pounds.

Considering the fruit is worth only the moderate value of one cent per pound on the tree, and the gain by the adoption of the triangular system is shown to be $34 per acre. This is essentially clear profit, as the cost of land, expense of cultivation, and the amount of taxes, are the same in either case, the only difference being in the cost of the increased number of trees, and the expense of their planting. Apply this computation to a ten-acre orchard for a term of ten years, and $3,400 is shown to be the not unlikely sum which a fruit grower may sacrifice rather than incur a little "bother" at the beginning. This system is of equal advantage in vineyards and small fruit plantations, and it affords superior facilities in all operations of cultivation and irrigation. It is sometimes called the "sextuple" system, from the character of a larger group which it forms, in which six equidistant trees stand in a circle about, and also equidistant from a seventh occupying its center. A gross error has occurred in the frequent application of the name "quincunx" to this method.

The true quincunx is described by four trees planted at the angles of a square, with a fifth placed midway between them. It is chiefly used in planting with reference to a future thinning out of the trees of an orchard, when those designed to be permanent shall have attained a considerable size. In such case the central tree in each group of five is ultimately removed, having served a profitable season of production until the growth of its neighbors demands its room. Sometimes a dwarf, or small growing sort, is thus permanently planted, and in occupying the otherwise vacant space, partially secures the advantage of the triangular mode. If extensive planting is to be done, the distance between the trees should be regulated by the habits of the kinds, as follows:

Apples and apricots, twenty-four to thirty feet.
Pears and cherries, twenty to twenty-four feet.
Peaches, plums, and prunes, twenty to thirty feet.
Quinces and dwarf pears, ten to twelve feet.
Oranges and lemons, twenty to thirty feet.
Olives and figs, twenty to thirty feet.

By skillful pruning nearly all kinds can be confined to a reduced space, and this is advocated by some, but demands more than average qualifications.

In a family orchard, embracing various kinds, convenience in cultivating recommends the adoption of uniform distances adjusted between the extremes best suited to each. About twenty feet will be found a fair average. By alternating the larger growing kinds, such as apple and apricot, with the smaller, such as pear, peach, and plum, each will more nearly appropriate its natural proportion of space.

LAYING OUT THE GROUND.

An orchard is an object of public notice, and the neatness and precision of its plan and planting, or the reverse, will generally be taken as an index to the character of the planter. A well laid out and well tended orchard commands almost universal admiration, while nowhere is slovenly work more conspicuous. Before proceeding with the following details, the novice in planting is exhorted to content himself, if necessary, to work by faith, and not be dismayed if at the outset he fails to comprehend the reason for each direction given, or its importance. Simply begin at the beginning, follow the rules as laid down, and all will grow clear as the work proceeds.

Having decided upon the method and distances, now prepare to stake off for planting. At this point neither a proper pride in the appearance of the orchard, nor a regard for true economy of time and labor, will allow haste to interfere with accuracy. Be assured that an error at the beginning will almost certainly be the occasion of indefinite repetition, resulting in vexation and loss of time. Provide a sufficient number of stakes for the ground to be laid out. Where available, laths answer the purpose excellently. Procure a long wire, for convenience not exceeding eighty yards, and of sufficient size to bear a strain without stretching. Less than one sixteenth of an inch in diameter is unreliable, as also are rope and twine. Obtain two iron rings, large enough to slip over the stakes readily. Select a clear space on a building or fence, and measure off thereon the distance the trees are to be apart. Drive a stout nail at each end of the space thus measured, leaving the heads projecting slightly. Now fasten one of the iron rings securely to one end of the wire, slip this ring over one of the nails and carry the wire to the other nail. Draw the wire tight, bend an angle over the nail, and at this angle fasten a small tag of cloth or other material easily seen, by means of a stout twine, well waxed and firmly drawn to prevent slipping. Have an attendant pass the wire forward, and hold this tag at the first nail while a second tag is located and attached as before directed. In like manner proceed until the other end of the wire is reached, to which another ring must be attached at the regular distance.

For clearness of illustration let the ring first attached be known as ring "A," the first tag as "1," and so on in order until reaching the second ring, to be called ring "B." Also, for the same purpose, it is assumed that the orchard plot ranges north and south and east and west, in its boundaries, and that operations commence at the southwest corner.

To lay out on the square system, begin by driving a stake at the spot selected for the southwest corner of the orchard, and at the beginning of the first row of trees. This and all outside rows should be sufficiently removed from any fence or boundary line to allow room between for the turning of a team in cultivating. About one rod is usually enough for this purpose. Slip ring "A" over this stake, proceed northward with the wire, draw it tight and secure it on the line for the first row of trees by driving a stake through the ring "B," at the same distance from the boundary line as at ring "A." Now set stakes outside the wire by each tag, driving them firmly and using care that they stand upright, to facilitate proving the work when all the stakes are set. This first row constitutes a base line for the orchard. The south line is next to be located at a true right angle with the base. To obtain this, slip ring "B" off the stake, take up the wire by tag "9," which carry southward and hold against stake "4" of the base line, while the assistant seizes the wire at tag "4" and draws it to the southeast until the wire tightens and with the base line forms a triangle. In the angle at tag "4" set a stake, which thus should be due east of stake "1" of the base line, ranging with which last the correct direction for the south line is obtained. Now stretch the wire to the east by this range, and stake at the tags as before. Next square the east line from the southeast corner, and set a stake for the northeast corner (in this instance omitting the intermediate stakes), carry the wire to the north side and stretch from the northeast to the northwest corner stakes. If from any inaccuracy the distance between the stakes does not correspond to the length of the wire, the northeast stake must be moved to the west or to the east to rectify. When all is correct, stake the east line in the usual manner. Now carry the wire across parallel with the base line; slip one ring over the second stake of the south line, and the other over the corresponding stake of the north line, and stake at the tags as before, for the second row of the orchard, and thus forward until the plot is filled. When this is done, glance along the rows in both directions, to detect and rectify any slight errors. Should the size of the orchard exceed the length of the wire, successive plots can be joined to cover any desired area. In such case care should be used to work from a corner, and in the direction corresponding to that first adopted.

For the triangular system, the wire must be differently arranged. Procure four rings for the purpose. First lay off the wire in respects as directed for the square method. Then attach to ring "A" another piece of wire, which, with a terminating ring, shall be in length precisely one half the distance between ring "A" and tag "1." The remaining ring lash securely to the wire midway between the last tag and ring "B." Let these rings be designated in their order of position, as rings "1," "2," "3," and "4." Lay out the base line or west row, as for the square, using rings "2" and "4." In case of orchards on the triangular plan, it is recommended that the base line be always located in a direction crossing that of prevailing heavy winds. By this means, the orchard presents a more compact front, and thus lessens the force of air currents among the trees. By beginning at the southwest corner protection against westerly winds is secured. Square the south line and stake the southeast corner, but instead of staking the south line as before by the tags, stake by a measuring pole made of a length corresponding to the distance the rows are to be apart, viz.:

If the trees are to be apart—

10 feet—rows should be .... 8 feet 8 inches apart.
12 feet—rows should be .... 10 feet 2⅖ inches apart.
14 feet—rows should be .... 12 feet ⅞ of inch apart.
16 feet—rows should be .... 13 feet 10½ inches apart.

18 feet—rows should be	15 feet 7 inches apart.
20 feet—rows should be	17 feet 4 inches apart.
22 feet—rows should be	19 feet ⅞ of inch apart.
24 feet—rows should be	20 feet 9½ inches apart.
30 feet—rows should be	26 feet apart.

Locate the northeast corner as before directed, and stake the north line the same as the south. Slip ring "1" over stake "2" of the south line, and ring "3" over stake "2" of the north line, and stake by the tags. Pull up both ring stakes, and move the wire for the next, or third row. In this case use rings "2" and "4;" stake and leave ring stakes standing. In like manner alternate the succeeding rows.

On perfectly even ground, the triangular system can be laid off by the use of an equilateral wooden triangle, each side being of a length equal to the distance between the trees. Lay off a base line as before; place two corners of the triangle against the first two stakes on the base, and the third corner will mark the place of the stake for the first tree of the second row. Next corner on the second and third stakes of the base, and stake the third corner for the second tree of the second row, after which further procedure will be easily understood.

On similar ground it can also be done by a system of intersecting half circles as follows: In a long strip of board bore two holes, each large enough to receive the orchard stakes, and as far apart as the distance between the trees. Lay out a base as before. By means of the hole drop one end "A" of the strip over the first stake of the base, the other end "B" projecting at right angles. By means of a pointed stick, thrust through the hole at "B," or a slight projection attached to the under side of the strip by the hole, mark a quarter circle on the ground by swinging the end "B" to the second stake of the base, over which it is slipped. Release the strip from the first stake and describe a half circle by swinging the end "A" to the third stake of base. In like manner, swing the end "B" to the fourth stake of the base, and so forward. At each intersection of the marks set a stake, which denotes the place for a tree of the second row, which in turn forms a base for laying out the third row in like manner. Where only one person is available for the work, and for extended spaces, the strip is more easily handled than the triangle. On an irregular surface neither the triangle nor strip will work accurately, while the wire will be found adapted for nearly all situations.

For the quincunx plan, use the wire as prepared for the triangular. Lay off the base line and locate the corners, but stake the north and south lines by a pole of a length one half the distance the permanent trees, or those at the angles of the group of five, are to be apart. Then stake the ground precisely as directed for the triangular method.

Planted by the foregoing plans, an acre of ground in equilateral form will contain of trees at the given distances apart:

	Square.	Triangular.	Quincunx.
10 feet	436	500	831
12 feet	303	347	571
14 feet	222	255	415
16 feet	170	195	313
18 feet	134	154	247
20 feet	108	126	199
22 feet	90	103	173
24 feet	76	86	137
30 feet	48	56	83

NOTE.—In giving the distances of trees of the quincunx in the foregoing table, the fifth or central tree is not taken into account.

CARE OF TREES BEFORE PLANTING.

Trees are surest to be in good condition if taken from the nursery immediately before planting, and subjected to the least possible handling and exposure. In very many instances this is not practicable, and some expedient must be adopted. On receipt of trees, if they cannot be at once planted, open the packages, cut the bundles, and removing all packing material from amongst the roots, heel in the trees in a deep trench previously opened in some well drained, mellow soil, being careful that all the spaces amongst the roots are filled with fine, moist dirt. If from any cause any trees are shriveled, or lack in plumpness of bark and buds, bury them entire in damp earth for five to seven days, when, if not badly injured, they will usually be restored.

PLANTING THE TREES.

Before digging the holes take a strip of wood five feet long, cut a notch at the middle, and at each end bore a hole large enough to admit a stake. Place the notch against the tree stake, and set a short stake in the ground through each of the end holes. Pull up the tree stake, remove the strip, and dig the hole for the tree. If the ground has been well prepared this need be no longer or deeper than to admit the roots of the tree in a natural position, and allow the tree to stand at the same depth that it grew in the nursery. Replace the strip on the two stakes, and the notch over the hole will indicate the exact place for the stem of the tree.

The greatest pains will rarely prevent some roots becoming bruised or broken in taking up and handling the trees. Before planting cut all these away to fresh, sound wood, using a keen knife, with a drawing cut sloping from the lower side of the root to the upper. If branched trees, shorten the limbs to the third or fourth bud from the trunk.

Three or four well-balanced branches should be selected to form the head of the tree, and all others cut away. Some prefer to prune to a bare stem, and form the head anew. Cut to an outside bud, if you wish the branch to grow outward; to an inside bud, if it already tends to spread too much. Start the cut opposite the base of the bud, and let it slope upward and terminate even with, or very slightly above, the tip of the bud. Don't be afraid to cut back.

The root, if stronger than the top requires, will quickly cause a growth to balance; but if the top is too large for the roots, it will draw upon the vitality of the tree. Trees not branched, cut back to a proper height, to form a low head, which, for various reasons, is most desirable. Three feet from the ground is high enough. As low as two feet is still better. Protect the roots from drying influences at all times as much as possible, especially from wind and sunshine. Two persons can work together with best advantage in setting trees—one to shovel in earth, the other to hold the tree upright in the notch of the strip with one hand, and with the other hand work fine surface soil among the interstices of the roots, which last must be naturally spread out, and the topmost held up while the lower are being covered. Plant so that the trees will stand at the same depth as they grew in the nursery, after the earth has settled. Be sure to leave no air spaces in filling; and when nearly full tread down gently with the feet, and finish with a loose surface, leaving the soil about the tree some two inches higher than the general surface, as it will afterwards settle to the level. In late planting, or a dry soil, use a pail of water, when roots are fairly covered, to settle the earth amongst them. It is a good plan to set the strongest roots toward the prevailing wind, to steady the tree.

Don't put anything whatever but clean earth under or in contact with the roots. Manure, if used, should be on the surface, where the rains will carry its properties to the roots in the form of a liquid, which is the only way they can take it up. Coarse manure used in this way is further valuable as mulch, which by some means should be supplied to all young trees. It preserves a cool temperature for the roots, and prevents escape of moisture. Straw answers well, if used five or six inches in depth, and covering the ground to a foot or more beyond the roots.

SUNDRY RECOMMENDATIONS.

Map the orchard immediately after planting, for, if delayed, labels will become lost and confusion result.

Do not allow any wire or string attaching a label to remain about the trunk or a large branch, as it is frequently overlooked until the ruin or serious injury of the tree calls attention to its presence.

Set two shakes or pieces of board cornering on the south side of the tree, to prevent sun scalding of the trunk, and to protect from borers. When the branches extend so as to shade the foot of the tree during the heat of the day, these can be removed. If headed low, this soon occurs.

See that the trees do not lack for moisture. Do not water unnecessarily, but watch for the first indications of approaching dryness, then apply a liberal quantity of water, cultivate and give no more until needed. Anticipate the need long enough to prevent a stoppage of growth. Unless you can irrigate, do not yield to the temptation to plant something amongst your trees. If you can irrigate, hoed crops need do no harm, provided the fertility they remove is restored by manures. Regard every weed as a pump which works night and day.

Cultivate after each rain, to retain a store of moisture, and occasionally during the dry season to prevent its escape. Rub off buds starting in wrong places, and do not let the young trees stunt themselves by overbearing.

Bind up any bruises on the trunk accidentally made in cultivating or otherwise, with a mixture of clay and fresh cow dung. In removal of any large limbs, coat the wound with a solution made by dissolving one fourth pound gum shellac in a pint of alcohol, which may be kept in a well corked bottle, and is ready for use at any time, being applied with a brush.

Post yourself regarding noxious insects, that you may detect their first appearance and stamp them out before they overpower you.

Finally, study your business. Seek information from all sources, especially your orchard. Be assured that nothing can supply the want of personal vigilance and industry.*

---

* Biennial Report, 1885-6, pp. 542-9.

XXIV.

INJURIOUS INSECTS.

Among the many injurious insects of most interest to the fruit growers, are the scale insects of the family *Coccidæ*, known by the popular name of "scale bugs" or "scale insects." Professor J. Henry Comstock, late United States Entomologist, during his visit to this State in 1880, studied the life, history, and form of the various scale insects on this coast. He reported quite fully upon their habits and general characteristics, and of this report I have made liberal use. I have inserted his scientific description of the various scale insects (Report United States Department of Agriculture, 1880), together with the introductory notes upon the characters, divisions, metamorphoses, organs, order, and families of the *Coccidæ*. In the scientific description of the various Coccinellidæ, the writings of this able and learned entomologist were also freely consulted.

The study of insect life is of the utmost importance to the fruit grower. He should be able to distinguish the injurious from the beneficial insects in his orchard, to destroy and prevent the introduction of the former, and to rear and foster the latter.

Numerous articles and reports have already been published, but in most of them the author has confined himself to historical notes, which have been more or less complete, and certainly very interesting, but the classification and scientific side of the question has been, in general, very much neglected. Powerful aid has been lent me by Professor D. W. Coquillett and Professor Albert Keobele, Special Agents of the United States Department of Agriculture. Let them accept here the expression of my gratefulness.

XXV.

SCALE INSECTS.

There is no group of insects which is of greater interest to horticulturists to-day, than that family which includes the creatures popularly known as "scale insects" and "mealy bugs." There is hardly any shrub or tree but that is subject to their attack, and in certain localities extensive orchards have been ruined by them. The minute size of the creatures, the difficulty of destroying them, and their wonderful reproductive powers, all combine to make them the most formidable of the pests of our orchards and ornamental grounds. It is only necessary to cite the mealy bugs of greenhouses, the oyster shell bark-louse of the apple, and the various species of scale insects destructive to citrus fruits to establish this fact.

Notwithstanding the great importance of this subject, comparatively little thorough work has been done on the species of this country. This is doubtless in a great part due to the difficulties attending a careful study of even a single species of this group, and the fact that the small size and plain appearance of the insects render them unattractive to most entomologists.

CHARACTERS OF THE COCCIDÆ.

The scale insects or bark-lice, and the mealy bugs, together with other insects for which there are no popular names, comprise the family known to entomologists as the Coccidæ. This is a division of the order *Homoptera*, to which belong also the plant-lice (Aphidæ), the Cicadas, the leaf-hoppers, and certain other insects.

We will not in this place enter into a discussion of the characters of the Homoptera or of the zoölogical relations of the Coccidæ to the other families included in that order. But referring those who are interested in these points to the text-books on entomology, we will proceed at once to a discussion of the Coccidæ.

In many respects this is a very anomalous group of insects, differing greatly even from closely allied forms in appearance, habits, and metamorphoses. Not only do the members of this family appear very different from other insects, but there is a wonderful variety of forms within the family; and even the two sexes of the same species in the adult state differ as much in appearance as insects belonging to different orders.

The most obvious characters in which the Coccidæ agree, and by which they may be distinguished from other insects belonging to the Homoptera, are the following: The females never possess wings; the males are winged in the adult state; but unlike other homopterous insects, possess only a single pair of wings, the second pair being represented by a pair of small club-like organs called *halteres*, each usually furnished with a bristle, which in all the species that I have studied is hooked and fits into a pocket on the anterior wing of the same side. The male, in the adult state, has no organs for procuring food, the mouth parts disappearing during the metamorphoses of the insect, and a second pair of eyes appearing in their place.

The strange forms assumed by certain species of bark-lice has led to their being mistaken for very different organisms. Thus the adult females of a species of a genus of bark-lice (Kermes) common on oaks in various parts of the world, have been commonly mistaken for galls. The gall-like objects on the twig of oaks are the females; the immatured males are very different in form, and are represented on the leaves. The resemblance to galls is shared somewhat by certain genera of this family. In fact, the family is termed by the French *Gallinsectes* on account of this resemblance.

There is a remarkable species belonging to this family found in the West Indies, in the furrows of land newly turned up, which from its resemblance to a pearl is known as the ground pearl, and is frequently sent to Europe in collections of shells under that name. It is stated by Guilding, who first described this insect under the name of *Margarodes formicarium*, that it occurs in the Bahamas, and is strung into necklaces and ornamental purses by the ladies. It was believed by Guilding that the ground pearls were parasitic on the ants, in and near the nests of which they were found. I think, however, that it is more probable that the so called pearls derive their nourishment from the roots of plants in the soil, and that they, instead of destroying ants, furnish them with food in the form of an excretion, as many other species of Coccidæ are known to do.

The habit of excreting a sweet fluid, which many species possess, together with the strange forms of the insects, has led to some strange mistakes. Thus one species which occurs on pine was at first taken for a nectar-secreting gland.

DIVISION OF THE COCCIDÆ INTO SUBFAMILIES.

Owing to the great diversity of form and structure among the species belonging to this family, they may be grouped into several subfamilies; and such a grouping is necessary before generalizations can be made respecting the habits and metamorphoses of the various species. Signoret in his monograph of this family divides it into four sections. We believe that each of these sections should rank as a subfamily, and will so consider them. They are characterized as follows:

1. DIASPINÆ.—This subfamily includes all the species of Coccidæ covered by a scale composed in part of molted skins and partly of a secretion of the insect.

Examples.—The oyster shell bark-louse, of the apple (*Mytilaspis pomorum*), the red scale of the orange (*Aspidiotus aurantii*), and Glover's orange scale (*Mytilaspis Gloverii*).

2. BRACHYSCELINÆ.—This subfamily includes certain species of Coccidæ which live in galls. All the described species are Australian. Consequently this subfamily will not receive further notice in this report.

3. LECANINÆ—The original characters of this subfamily as given by Signoret are as follows: Species either naked or inclosed, or simply covered with waxy calcareous or filamentary material; most of the females after impregnation taking on a different form, and, once fixed, remaining so for the rest of their lives, although while young they retain the power of moving under certain circumstances.

4. COCCINÆ.—Signoret originally gave the characters of the Coccinæ as follows: Females keeping the form of the body with the segments distinct until the end, and also retaining the power of motion; they are naked or covered more or less with a waxy whitish excretion, filamentary, and more or less spumous.

These characters were afterwards found to be insufficient to separate the two groups as the genus *Kermes*, which, from the study of the young larva, belongs evidently to the Coccinæ, is fixed and covered with a hard horny substance, hiding the segmentation and giving it precisely the appearance of a Lecanium. Signoret, therefore, substituted the following characters: Lower lip 1-jointed in the Lecaninæ, multiarticulate in the Coccinæ; anal plates present in the Lecaninæ, absent in the Coccinæ; anal extremity with the Coccinæ divided into two lobes, each furnished with a long bristle.

Examples of Lecaninæ.—The black scale of California (*Lecanium oleæ*, Bernard), the maple bark louse (*Pulvinaria innumerabilis*, Rathvon), the lac insect (*Carteria lacca*, Ker.).

Examples of Coccinaæ.—The mealy bugs (*Dactylopius*), the cochineal insect (*Coccus cacti*, Linn.).

METAMORPHOSES OF THE COCCIDÆ.

The changes through which a scale insect passes in the course of its development are very remarkable. But as the metamorphoses and habits of each division of the family are somewhat peculiar, it is necessary to consider each subfamily by itself. We will discuss, in this place, only the first subfamily.

1. THE DIASPINÆ.—The newly hatched scale insect is oval in outline, much flattened, furnished with six legs, a pair of antennæ, and an apparatus for sucking the juices from plants. At this stage of its existence it is very small, a mere speck, which the untrained eye could only with difficulty detect. By means of a lens, however, these minute creatures can be

seen crawling in all directions over the leaves or bark of an infested tree. After wandering for a time, usually but a few hours, or even less, the young scale insect settles on some part of the plant, inserts its beak, and, drawing its nourishment from the plant, begins its growth at the expense of its host. In a short time there begins to exude from the body of the larva fine threads of wax, which are cottony in appearance. The excretion of this wax continues until the insect is completely covered by it. The rate at which this excretion is produced varies greatly. Thus, larvæ of the red scale of Florida (*Aspidiotus ficus*), which were only one day old, were found to be completely covered by the cottony mass which they had excreted, while the larvæ of Glover's scale (*Mytilaspis Gloverii*) did not become entirely covered until they were six days old. Sooner or later the larva begins to excrete a pellicle, which, although very thin, is dense and firm in texture. The mass of cottony fibers either melts or is blown away, or, as in certain species of Aspidiotus, a portion remains as a white dot or ring on the center of the scale. After a period, which, in several species that we have studied, is about one half of the time from the hatching of the larva to the emerging of the male, or one third of the time from the birth of the female to the date at which she begins ovipositing, the larva sheds its skin. In some species this does not take place until after the beginning of the formation of the permanent scale, and in such cases the molted skin adheres to the inner surface of the scale, and cannot be seen while it is in its normal position on the plant. This is true of many species belonging to the genus Aspidiotus (*A. ficus*, *A. citri*, *A. perniciosus*, and others). In these species the position of the exuviæ is indicated by a nipple-like prominence, often marked by a white ring or dot, which is the remains of the cottony mass first excreted. In other species the molt takes place before the beginning of the excretion of the permanent scale. In these the larva skin is plainly visible either upon the surface of the scale, as in certain species of Aspidiotus (*A. nerii*), and in Diaspis, or at one extremity, as in Mytilaspis. Sometimes, however, the larval skin is covered by a delicate transparent layer, which, I think, is the melted or compacted remains of the cottony mass excreted by the young larva.

This change which the larva undergoes at this molt is a very remarkable one, appearing to be a retrogression instead of an advancement to a more highly organized form, as is the rule in the development of animals. With the skin are shed the legs and antennæ. The young scale insect thus becomes a degraded grub-like creature without organs of locomotion. The mouth parts remain, however, in a highly developed state, and are well fitted to perform their functions. This apparatus is not the least remarkable thing in the structure of these insects. It is terminated by a thread-like organ, which is frequently much longer than the body of the insect, and is composed of four delicate hair-like bristles. By means of this organ the insect is firmly attached to the plant, and draws its nourishment therefrom. From this stage the development of the sexes differs.

The second and last molt of the female takes place, in those species which we have studied most carefully, when she is about twice as old as when the first molt occurred. The change in appearance at this molt presents nothing remarkable. The second cast skin is joined to the first, and with it forms a part of the scale which covers the body of the insect. Sometimes, as in the genus *Forinia*, this molted skin is very large, and constitutes the greater part of the scale; but more commonly the exuviæ form but a small proportion of the scale, the greater part of it being excreted subsequently to the second molt. Soon after the second molt of the females takes place the adult males emerge, and doubtless the impregnation of the females occurs at once. After this the body of the female increases in size, becoming distended with eggs. The oviposition takes place gradually, and in those species that we have studied begins when the female is about three times as old as when the first molt occurred. In other words, the three intervals between the birth of the female and the first molt, between the latter and the second molt, and between this and the beginning of oviposition, are about equal. The eggs are deposited beneath the scale, the body of the female gradually shrinking, and thus making room for them. Some species, however, are viviparous.

The male scale insect, during the early part of its larval life, is indistinguishable from the female. The first molt occurs at the same time and is accompanied by a similar change, the male larva like the female losing its legs and antennæ. The second molt is also synchronous with the second molt of the female; but here the similarity in form between the two sexes ceases. Even before this molt takes place there may be observed the formation of rudimentary limbs beneath the transparent, memberless skin of the larva; and after this skin is shed, the male, now in the pupa state, differs remarkably from the female. The male pupa has long antennæ, and its legs and wings, although in a rudimentary state, are very large. The duration of the pupa state in those species which we have bred, is short—but a few days; and then after the third casting of the skin the adult male appears. The anterior wings, though very delicate, are large, and enable the male to fly readily. The posterior wings are represented only by a pair of halteres. These insects resemble in this respect the flies, gnats, and other insects belonging to the order Diptera, or two-winged insects. The posterior end of the body is furnished with a style which is sometimes nearly as long as the remainder of the body, and is the external organ of reproduction.

EXPLANATION OF CHARACTERS USED IN CLASSIFICATION OF THE COCCIDÆ.

Many members of this family differ so greatly from the ordinary forms of insects that, in classifying them, it becomes necessary to use characters peculiar to them. This is especially true of the subfamily Diaspinæ, where the scale and the last segment of the female present nearly all of the tangible specific characters. Much stress has been laid by certain writers upon the characters presented by the male. But, although we have done our best, we have found little in this sex that is of value for separating closely allied species, that can be put into words. We have bred the males in much greater numbers, both of species and of specimens, than has ever been done before by a single student. These have been figured very carefully, the drawings being made on a large scale, and reduced by photography. Great care has been taken to represent accurately the shape and relative size of the different parts of the body. The results of our labor in this direction are given with the hope that in the future they may be found of more value than appears to us now. The disappointment which we have experienced in the study of the males has been relieved by the success which has attended our study of the margin of the last segment of the females of the Diaspinæ. Here we have found a set of characters which have received almost no attention heretofore, but which are almost the only ones which can be relied upon for separating closely allied forms.

SCALE.—The term *scale* is applied to the thin pellicle which covers the dorsal surface of the bodies of all the Diaspinæ. It is composed in part of molted skins, of which *two* are attached to the scale of the female, and *one* to that of the male; these are termed the *exuviæ*. There is also a layer composed of excretion, and, in some cases at least, of the ventral half of the molted skins between the body of the insect and the bark of the plant upon which it is. This layer varies greatly in thickness, and presents in some instances specific characters. I do not find that it has been noticed by authors. In the descriptions of species I have termed it the *ventral scale.*

LAST ABDOMINAL SEGMENT.—As stated under the head of *Metamorphoses,* the members of the subfamily Diaspinæ undergo a remarkable change at the time of the first molt, losing their legs and antennæ, and thus becoming apparently less highly organized than in the larval state. At the same time the last abdominal segment assumes a remarkable form, becoming flattened and fringed with numerous appendages. In the male this character is transient, the form of this segment changing gradually, previous to the second molt, to that which it bears in the pupa state. In the female, however, this segment becomes hardened, apparently, by the deposition of chitine, and the peculiar form is preserved throughout the remainder of the insect's life. In fact, so completely are these parts chitinized that their peculiar forms are preserved even after the insect is dead and the remainder of its body is so shriveled as to be unrecognizable.*

The very careful study which we have made of this segment and its appendages, embracing an examination of several thousand mounted specimens, has demonstrated that the characteristics here presented are very constant within the limits of each of the species which we have investigated. In fact they are the only distinctions upon which we have been able to place implicit confidence in separating closely allied forms. I have therefore given considerable space in the description of species, to these characteristics. In each case the description has been based upon a study of the adult female.

Upon the dorsal surface of the segment are usually several lines of holes which are the openings of glands which excrete a part at least of the substance of which the scale is composed. I have studied specimens in which there was a thread of excretion extending from each of these openings to the scale. Although these openings are very prominent, I have failed to find that they present specific character, and so have made no use of them in classification, and have figured them in but few instances. In the more transparent species they are easily seen through the body when examining it from the ventral side, and unless a good microscope is used, the openings of the two surfaces will be confused. Near the center of the ventral surface of this segment is the *vaginal opening,* which is large, and which is represented in nearly all of our drawings of this segment.

In most species there is a greater or less number of peculiar openings arranged in groups around the vaginal orifice. These are termed *spinnerets* (*filieres*) by Signoret, a term which is also applied to various other openings, tubes, and tubular spines which occur on this and other segments of the body, and which are supposed to be openings to glands which excrete the covering of these insects. The pores which are arranged in groups about the vaginal opening differ remarkably from others in being compound, each spinneret being a circular plate perforated by several small openings.

The presence or absence of these spinnerets, the number of them in each group, and the number of groups, are characters of some value in classification. They cannot, however, be relied upon implicitly. The number of spinnerets in each group varies more or less in every species, and even upon the two sides of the body of the same individual. But as this variation is usually quite limited, it does not render this character valueless. In most species the number of the groups of these spinnerets is either four or five. When they are five, one is situated cephalad of the vaginal opening, and two on each side of it. These groups I have designated as the anterior, anterior-lateral, and posterior-lateral, respectively. When there are only four groups, it is the anterior one that is wanting. Other forms of grouping of the spinnerets exist and will be described in the descriptions of the species in which they occur. On the posterior margin of the segment are situated numerous appendages, of which three forms may be distinguished; these I have termed lobes, spines, and plates.

The *lobes* are usually the most conspicuous of the appendages of this segment. They appear to be inserted in a groove between the posterior edges of the upper and lower surfaces of this segment. But in two species which I have succeeded in dissecting (*A. obscurus,* and an undescribed species), I found each lobe to consist of a prolongation of the margins of the dorsal and of the ventral walls of the segment; these prolongations being much thickened and joined at their distal extremities. This thickening of the body wall extends anteriorly for a short distance upon both the dorsal and ventral sides of the body, but chiefly upon the former. The number of these lobes varies from one to four pairs.

In some species a part of the *lateral margin* of the segment appears to be of the same structure as the lobes.

In certain species *thickenings* of the body wall occur near the prolongations of the lobes, but more or less distinct from them. In each of the species which I have dissected these thickenings are on the dorsal side of the body; this point can be determined only by splitting the specimen and studying the dorsal and ventral halves of the body separately. In an unmutilated specimen the thickenings of the body will appear like organs within the body. The number, size, and position of these thickenings afford good specific characters.

In certain species the posterior margin of the segment is incised two or three times (usually twice) on each side of the meson. These incisions, and the edges of them, which are usually thickened, afford characters of importance. As with the thickenings described above, it is difficult to determine from an unmutilated specimen upon which surface these incisions are. They are represented in all of our drawings as they appear when seen from the ventral side.

The *spines* are situated near the posterior margin of the segment. There are usually two, one on the dorsal surface, and one on the ventral surface, associated with each of the lobes. Others are situated at various intervals between the lobes and the penultimate segment. In many instances these spines appear to be tubular, and I have repeatedly seen what appeared to be threads extending from them; hence, they may be spinnerets.

In the descriptions the lobes and spines are numbered, beginning at the meson; the corresponding lobes of each side of the body bearing the same numbers. They are thus considered in pairs, as are the legs and wings of other insects, excepting that in numbering the lobes and spines the numbers increase cephalad instead of caudad.

Under the head of *plates* I have classed all the remaining appendages which fringe this segment. They are usually long, flattened, and more or less notched or toothed. Sometimes, however, they are hair-like or spine-like. This is especially the case on the side of the segment; here, too, the form and number are not so constant as it is between the lobes. When studying the ventral surface of this segment, a clear spot on the middle

---

* In one instance I removed from under their scales the dried bodies of scale insects which had been in a collection for twenty-five years, and found that the characters presented by this segment were perfectly preserved.

line of the body is usually visible. This is the *anal opening*, and is really on the dorsal surface of the segment; its apparent position is represented in the figures, and, as will be readily seen, varies greatly in different species.

There are many other openings and appendages of this segment, which we have not represented in our figures, as no use has been made of them in classification, and the representation of them would only tend to confuse the illustrations.

TERMS DENOTING POSITION OR DIRECTION OF ORGANS.

The use of the terms upper, inner, outer, before, behind, and similar expressions in the technical descriptions of animals, or of their parts, has led to so much confusion that there is a strong movement on the part of the leading zoölogists in favor of a more exact anatomical nomenclature. Although many of the terms proposed may never be adopted, others, which are obviously appropriate, definite, and concise, are rapidly coming into use. A few terms of this class are introduced into this report. The position and direction of all parts and organs are referred to an imaginary plane dividing the body into approximately equal right and left halves. This middle plane, or any line contained therein, is designated as the *meson*. The corresponding adjective is *mesal*, and the adverb *mesad*. In combination meson becomes *meso*. The well known adjectives dorsal, ventral, dextral, sinistral, lateral, proximal, distal, cephalic, and caudal are used in preference to less definite terms, as are also the corresponding, but less familiar forms, dorsad, ventrad, etc.

USEFUL PRODUCTS OF THE COCCIDÆ.

Although the occasion for this report is the great injury to agriculture caused by certain species of scale or bark-lice, it should be borne in mind that there are insects belonging to this family which are beneficial to man. In some instances these insects or their products have been of great commercial importance, especially in ancient times, and to this date the products of certain species are used extensively.

The dye-stuff known as kermes, or *Granum tinctorium*, is made from the dried bodies of the females of *Coccus ilicis* of Linnaeus, a species of bark-louse which lives upon a small evergreen oak (*Quercus coccifera*), a tree which is native of Asia and the countries bordering on the Mediterranean. This dye has been in use ever since the time of Moses, and Pliny states that the inhabitants of Iberia paid to the Romans half their tribute in kermes. The use of this dye has, however, been superseded to a great extent by cochineal, which gives colors of much greater brilliancy. Cochineal is also an insect belonging to this family; it is the *Coccus cacti* of authors, and is a native of Mexico. It feeds upon various species of the Cactaceæ, more especially *Opuntia coccinilifera*. Although this insect is a Mexican species, it is now cultivated in India, Spain, and other countries, and I have received living specimens which were collected upon a wild cactus near Fernandina, Fla. The dye-stuff consists of the female insects, which, when matured, are brushed off the plants, killed, and dried. The entire insect is used. From cochineal, lake and carmine are also prepared. Cochineal is now being superseded by aniline dyes, which are made from coal tar.

The scarlet grain of Poland (*Porphyrophora polonica*) is still another bark-louse which has been used to a considerable extent as a dye-stuff.

The stick lac of commerce, from which shell-lac, or shellac, is prepared, is a resinous substance excreted by a bark-louse known as *Coccus lacca* (*Carteria lacca*, Ker.), which lives upon the young branches of several tropical trees, especially *Ficus indica*, *F. religiosa*, and *Croton lacciferum*. And the coloring agent known as lac dye is also prepared from stick lac.

Another true lac insect occurs in Arizona upon the stems and branches of *Larrea mexicana*. Judging from the specimens in the museum of this department, the lac occurs on this plant in sufficient quantity to be of economic importance.

A bark-louse, which was described under the name of *Coccus manniparus* (*Gossyparia maniparus*, Sign.) "is found upon *Tamarix mannifera*, Shr., a large tree growing upon Mount Sinai, the young shoots of which are covered with the females, which, puncturing them with their proboscis, cause them to discharge a great quantity of a gummy secretion, which quickly hardens and drops from the tree, when it is collected by the natives, who regard it as the real manna of the Israelites."—Westwood.

China wax is another substance for which we are indebted to this family. It is the excretion of an insect known as *Pe-la* (*Ericerus pe-la*, Westwood). In fact, many species of this family excrete wax in considerable quantities. I have found three species in this country which, if they can be easily cultivated, produce wax in sufficient quantities to be of economic importance.

RED ORANGE SCALE.

Aspidiotus aurantii, Maskell.

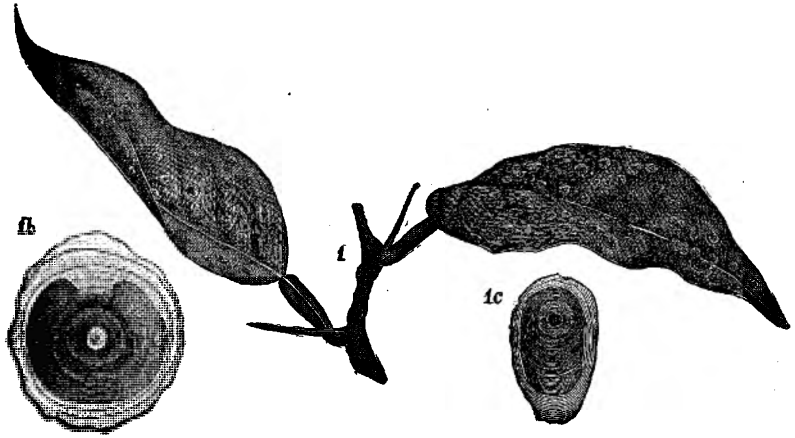


Figure 40.

[A circular scale, known by the popular name of "Red Scale," on account of the color of its shell. It infests citrus trees principally. (1b) The female scale—enlarged. (1c) The male scale—enlarged. (1) Infested twig, showing the scales on the leaf and branch.]

Scale of Female.—This scale resembles that of *Aspidiotus ficus* in shape, size, and the presence of the nipple-like prominence, which indicates the position of the first larval skin; but it can be readily distinguished from the scale of that species as follows: It is light gray, and quite translucent; its apparent color depending on the color of the insect beneath, and varying from a light greenish yellow to a bright reddish brown; the central third (that part which covers the second skin) is as dark and usually darker than the remainder of the scale; and when the female is fully grown the peculiar reniform body is discernible through the scale, causing the darker part of the outer two thirds of the scale to appear as a broken ring.

Female.—The female is light yellow in color in the adolescent stages, becoming brownish as it reaches maturity. When fully developed the thorax extends backward in a large rounded lobe on each side, projecting beyond the extremity of the abdomen, and giving the body a reniform shape. The last abdominal segments presents the following characters:

I have been unable to detect the presence of the groups of *spinnerets*, although I have examined many specimens prepared in various ways.

There are three or four pairs of well developed *lobes*. The lobes of the first pair are abruptly narrowed at about half their length; the notch on the mesal margin is often nearer the distal end of the lobe than that of the lateral margin. The lobes of the second and third pairs are abruptly narrowed at half their length on the lateral margin, and often bear a notch on the median margin near the distal end. Laterad of the most lateral plate is a triangular lobe of the *margin of the segment*, which is serrate.

The *plates* are all deeply fringed, those between the first pair of lobes on their distal margin, the others on their lateral margins. They are all well developed, exceeding the lobes in length, and are situated as follows: Two between the first pair of lobes, two between the first and second lobes of each side, two between the second and third lobes, and three between the third lobe and the lobe of the margin of the body. The first plate laterad of the second lobe, and three plates laterad of the third lobe are each deeply bifurcated, and each bifurcation is fringed on the lateral margin.

On the ventral surface there is a *spine* near the base of the lateral margin of each of the four lobes except the first; there are also about three small slender spines on the margin of the body near the penultimate segment. On the dorsal surface there is a spine with each lobe. The first spine is very slender and inconspicuous, but as long as the lobe; it is situated at the base of the lateral margin of the lobe in such a manner that it can be moved either above or below the lobe. Each of the other spines is situated near the middle of the base of the lobe it accompanies.

Egg.—I have not seen the eggs of this species, excepting those taken from the body of the female. And as I have repeatedly found young larvæ under the scales, I am led to believe that the species is viviparous.

Scale of Male.—The scale of the male resembles that of the female, excepting that it is only one fourth as large; the posterior side is prolonged into a flap, which is quite thin, and the part which covers the larval skin is often lighter than the remainder of the scale.

Male.—The male is light yellow, with the thoracic band brown, and the eyes purplish black.

Habitat.—I have observed this species in several groves at San Gabriel and Los Angeles. At the first named place, where it is very abundant, it is said to have first appeared on a budded orange tree which was purchased at one of the hothouses in San Francisco. At Los Angeles it appears to have spread from six lemon trees which were brought from Australia. At first I considered this an undescribed species, as I could find no description of it either in American or European entomological publications. I therefore described it in the "Canadian Entomologist" under the name of *Aspidiotus citri*. Afterward I obtained copies of the papers "On some Coccidæ in New Zealand," by W. M. Maskell, published in the transactions and proceedings of the New Zealand Institute, and found that he had described an insect infesting oranges and lemons imported into New Zealand from Sydney, which was either identical with or very closely allied to the red scale of California. I at once sent to Mr. Maskell for specimens of the species described by him. These have just been received, and prove to be specifically identical with those infesting citrus trees in California. Thus the question as to source from which we derived this pest is settled beyond a doubt. It infests the trunk, limbs, leaves, and fruit. The infested leaves turn yellow, and when badly infested they drop from the tree. This species spread quite rapidly; and from what I have seen of it, I believe that it is more to be feared than any other scale insect infesting citrus fruits in this country.

Specimens of this insect colonized on orange trees in the breeding room of the department, passed through their entire existence in a little more than two months; hence, it is probable that in the open air in Southern California there are at least five generations each year, and possibly six. The mode of the formation of the scale in this species very closely resembles that of *A. ficus*, described at length in this report. The ventral scale, however, reaches a greater degree of development in *A. aurantii* than in *A. ficus*. At first it consists of a very delicate film upon the leaf; when the second molt occurs it is strengthened by the ventral half of the cast skin, the skin splitting about the margin of the insect, the dorsal half adhering to the dorsal scale, and the ventral half to the ventral scale. Later, after the impregnation of the female, the ventral scale becomes firmly attached to the dorsal scale and to the insect, so that it is almost impossible to remove an adult female from her scale.

Remedy.

This scale insect infests citrus trees mostly, and as they must be treated in the summer, when the trees are growing, and as fruit is always on the trees, the remedy must be such as will not injure either.

The following remedy has given the best satisfaction:

Rosin	20 pounds.
Caustic soda (70 degrees)	8 pounds.
Fish oil	3 pounds.
Petroleum	2 pounds.
Water	100 gallons.

Directions.—The rosin, caustic soda, and fish oil, with twenty gallons of water, are put together and boiled thoroughly for four hours, and then the petroleum is added, and the whole well stirred. This compound is put while hot into the tank to which the pump is attached, and the remaining eighty gallons of warm water added. The mixture must be stirred in the tank while spraying. The emulsion becomes perfect and flows freely. The petroleum is added to prevent the caustic soda from burning and staining the fruit. If the ground is dry, the orchard should be irrigated before or soon after spraying. During hot weather (80 degrees to 90 degrees) less caustic soda should be used, otherwise the leaves will fall and the fruit drop or be stained. The greatest care must be exercised in the preparation of the mixture, as in this lies the secret of success.

Hydrocyanic Acid Gas.

The hydrocyanic acid gas treatment is by far the best remedy for all kinds of scale insects. Experiments have been carried on for some time with very satisfactory results. The cost of application had deterred its use, the chemicals being quite expensive. Recently a new process in the handling of the chemicals has been discovered, which reduces the cost of application on medium size trees to about 6 cents per tree. The process is very simple and inexpensive. The generator consists of an earthen or leaden jar, into which is placed three ounces of water by measure; to this is added from separate vessels, at the same time, one and one half ounces cyanide of potassium by weight, and one and one half ounces sulphuric acid by measure. A piece of burlap is placed over the generator, the object being to prevent the too rapid escape of the gas as it is generated. The tent is left on the tree fully fifteen minutes. The tent must be perfectly opaque. The operations conducted at night have been the most successful, as the sun's rays must be excluded to insure satisfactory results.

FLORIDA RED SCALE.

Aspidiotus ficus, Riley.

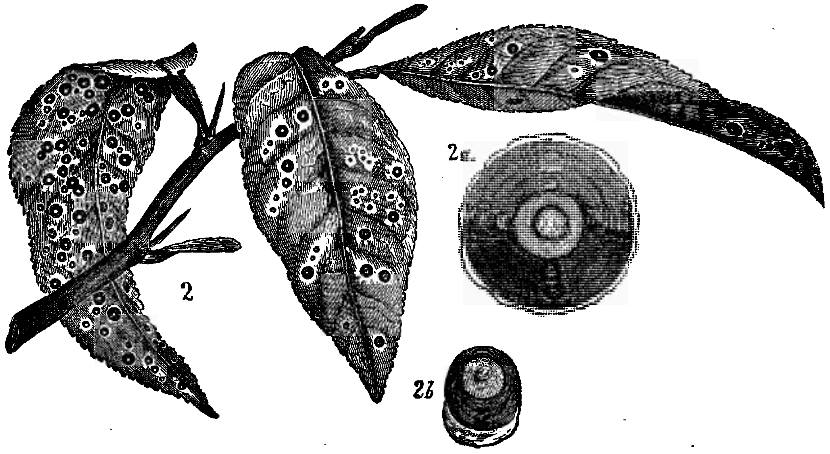


Figure 41.

[A red scale insect which infests citrus trees in Florida, settling on the wood, leaves, and fruit. (2) Leaves infested by the scales. (2*a*) The female scale—enlarged. (2*b*) The male scale—enlarged.]

Scale of Female.—The scale of the female is circular, with the exuviæ nearly central; the position of the first skin is indicated by a nipple-like prominence, which, in fresh specimens, is white, and is the remains of a mass of cottony excretion, beneath which the first skin is shed. The part of the scale covering the second skin is light reddish brown; the remainder of the scale is much darker, varying from a dark reddish brown to black, excepting the thin part of the margin, which is gray. When fully grown the scale measures 2 mm. (.08 inch) in diameter. In some specimens the part covering the exuviæ is depressed, and when the scale is removed from the leaf and viewed under a microscope with transmitted light, the exuviæ, which are bright yellow, show through this part, causing it to appear as described by Mr. Ashmead.

Female.—The body of the female is nearly circular; it is white, marked with irregular yellow spots. The last segment presents the following characters:

There are four groups of *spinnerets*; the anterior laterals consist each of about eight, and the posterior laterals of about four.

There are three pairs of well-developed *lobes*. The first and second lobes of each side are abruptly narrowed toward their posterior extremities on the lateral edges at about one half their length; the third lobe is narrowed by a succession of notches on its lateral margin; all the lobes are widened slightly toward their bases on their mesal margins.

The *lateral margin* of the segment appears to be of the same structure as the lobes; it is serrate, deeply notched two or three times, and ends posteriorly in a lobe.

There are six *thickenings of the body wall* on each side of the meson. These are linear, oblong, with the anterior ends rounded and slightly expanded, and are more or less nearly parallel with the meson. One arising from the mesal margin of the first lobe exceeds it a little in length; one from the lateral margin of the same lobe extends nearly to the anus; one each from the mesal margins of the second and third lobes are about twice the length of the lobes, and with the anterior extremities further from the meson than the posterior; one from a point about midway between the second and third lobes extends anteriorly beyond any of the other thickenings; and, finally, one from the lateral margin of the third lobe is short, inconspicuous, and sometimes wanting.

Between the first pair of lobes are two wide, oblong *plates*, with the distal margin of each deeply fringed; between the first and second lobes of each side are two, and between the second and third lobes are three similar plates; between the third lobe and the one at the end of the thickened lateral margin are three large compound plates, each consisting of two long branches, which are toothed deeply and irregularly on their lateral edges.

On the ventral surface, near the margin of the segment, are situated four pairs of spines, there being a spine at the base of the lateral margin of each lobe, including the lobe of the thickened margin of the segment described above. On the dorsal surface there are only three pairs of spines, none being present on the first pair of lobes; each spine is situated near the middle of the base of the lobe it accompanies.

Eggs.—The eggs are pale yellow.

Scale of Male.—The scale of the male is about one fourth as large as that of the female; the posterior side is prolonged into a thin flap, which is gray in color; in other respects the scale appears like that of the female.

Male.—The male is light orange yellow in color, with the thoracic band dark brown, and the eyes purplish black. It very closely resembles the males of *A. aurantii*, but differs from that species in being a smaller insect, with shorter antennæ, longer style, wider thoracic band, and with the pockets of the wings for the insertion of the hair of the poisers farther from the body.

Remedy.

The remedy used for the red scale (*Aspidiotus aurantii*) will prove effectual on this scale.

WALNUT SCALE.

Aspidiotus juglans regiæ, Comstock.

Scale of the Female.—The scale of the female is circular, flat, with the exuviæ laterad of the center; it is of a pale grayish brown color; the exuviæ are covered with secretion; the position of the first skin is indicated by a prominence which is pink or reddish brown. The ventral scale is a mere film which adheres to the bark. Diameter of scale, 3 mm. (.13 inch).

Female.—The color of the female when fully grown is pale yellow, with irregular orange-colored spots; oral setæ and last segment dark yellow. This segment presents the following characters: There are either four or five groups of *spinnerets;* the anterior group is wanting or consists of from one to four spinnerets, the anterior laterals consist of from seven to sixteen, and the posterior laterals of from four to eight.

There are two or three pairs of *lobes*. The median lobes are well developed, but vary in outline; the second lobe of each side is less than one half as large as the median lobes, elongated, and with one or two notches on the lateral margin; the third lobe is still smaller and pointed, or is obsolete.

There are two pairs of incisions of the margin, one between the first and second lobes of each side, and one between the second and third lobes; they are small, but are rendered conspicuous by the thickenings of the body wall bounding them.

The *plates* are simple, inconspicuous, and resemble the spines in form. The larger ones are situated one caudad of each incision.

The *spines* are prominent, especially those laterad of the second and third lobes; the fourth spines are a little nearer the first lobes than the penultimate segment; and the fifth are near the penultimate segment; there is also a spine at or near the union of the last two segments.

Scale of Male.—The scale of the male resembles that of the female in color; it is elongated, with the larval skin near the anterior end; this skin is covered by excretion, but its position is marked by a rose-colored prominence, as in the scale of the female; the anterior part of the scale is much more convex than the posterior prolongation, which is flattened. There is a rudimentary ventral scale in the form of two narrow longitudinal plates, one on each side of the lower surface of the scale. Length, 1.25mm. (.05 inch).

Male.—Only dead males have been found; these were too much shriveled to be of use for description.

Habitat.—On the bark of the larger limbs of English walnut (*Juglans regia*). Described from sixty-three females, and many scales of each sex.

Remedy.

This scale as yet has not done much injury to the walnut trees in this State. The old trees do not suffer from their attacks, as it only infests the main limbs. The scale also infests apple trees. The best remedy is the following, applied when the trees are dormant:

Lime	25 pounds.
Sulphur	20 pounds.
Salt	15 pounds.

Directions.—Take ten pounds of lime, twenty pounds of sulphur, and twenty gallons of water; boil until the sulphur is thoroughly dissolved. Take the remaining fifteen pounds of lime and fifteen pounds of salt, and when thoroughly slacked, mix together and add enough water to make in all sixty gallons of solution; strain and spray warm.

OLEANDER SCALE.

Aspidiotus Nerii, Bouche.

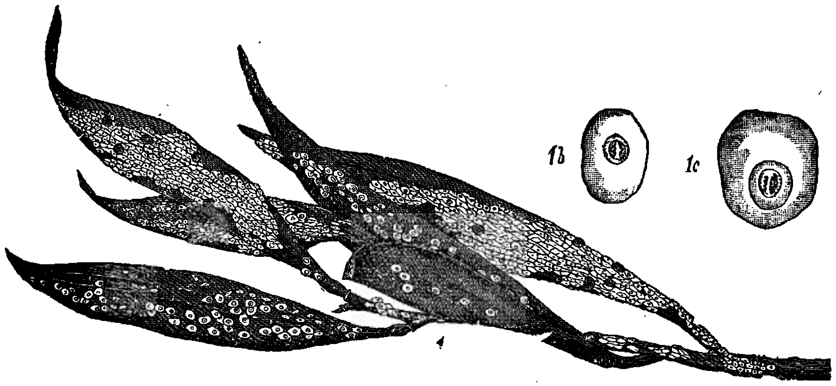


Figure 42.

[A small whitish scale, infesting the oleander and the olive, and also lemons, but it never gets on the tree itself. (1) A twig infested by the scales—always found on the under side of the leaf. (1*b*) Scale of the male. (1*c*) Female—all highly magnified.]

Scale of the Female.—The scale of the female is flat, whitish or light gray in color, and with the exuviæ central or nearly so. Exuviæ dull orange yellow, the first skin usually showing the segmentation distinctly; the second skin more or less covered with secretion; often appearing only as an orange-colored circle surrounding the first skin. Ventral scale a mere film applied to bark of plant. Diameter of fully formed scale, .08 inch.

Female.—The body of the adult female is nearly circular in outline, with the abdominal segments forming a pointed projection; light yellow in color, mottled with darker yellow. The last segment presents the following characters:

The anterior lateral groups of *spinnerets* consist each of about nine, and the posterior laterals of about seven.

There are three pairs of *lobes;* the first and second are well developed, the third is quite small.

The *plates* are well developed; they are long and usually fringed. There are two small ones between the median lobes. Those of each side are as follows: Two between the first and second lobes, three between second and third lobes, and usually seven laterad of the third lobe, of which usually four are fringed and three simple. The number of the last named group varies from four to nine.

There is on each surface of the segment a *spine* accompanying each lobe; one between the fourth and fifth plates laterad of third lobe, and one at about one third the distance from this spine to the penultimate segment. In each case the spine on the ventral surface is a little laterad of the one on the dorsal surface.

Eggs.—The eggs are very light yellow in color.

Scale of Male.—The scale of the male is slightly elongated, with the larval skin nearly central; it is snowy white, with the larval skin light yellow; longest diameter, 1 mm. (.04 inch).

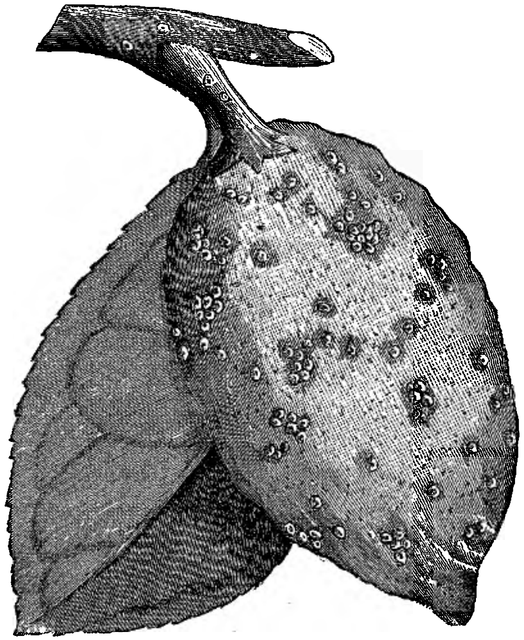


Figure 43.

[Oleander scale (Figure 43) as it appears on the lemons, seldom on the branch and leaf.]

Remedy.

This scale does not confine its attacks to the oleander, but also gets on the olive and the lemon—on the leaves of the former, and only on the fruit of the latter. It has often been mistaken for the red scale, as it assumes a pinkish tint when on lemons. The remedy applied for the red scale (*Aspidiotus aurantii*) is also effective for this one (see red scale remedy), as both have hard shell (*aspidiotus*) scales or coverings.

PERNICIOUS SCALE.

Aspidiotus perniciosus, Comstock.

Scale of Female.—The scale of the female is circular and flat, with the exuviæ central, or nearly so. The scale is gray, excepting the central part (that which covers the exuviæ), which varies from a pale yellow to a reddish yellow; sometimes the central part is black, resembling the scale of the male, and in some specimens the outer part of the scale is marked by radiating ridges. Diameter, 2 mm. (.08 inch).

Female.—The body of the female is yellowish and almost circular in outline; the segmentation is distinct, though not conspicuous. The last segment presents the following characters:

There are only two pairs of *lobes* visible; the first pair converge at tip, are notched about midway their length on the lateral margin, and often bear a slight notch on the mesal margin near the tip. The second pair are notched once on the lateral margin.

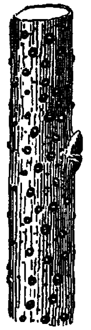


Figure 44.

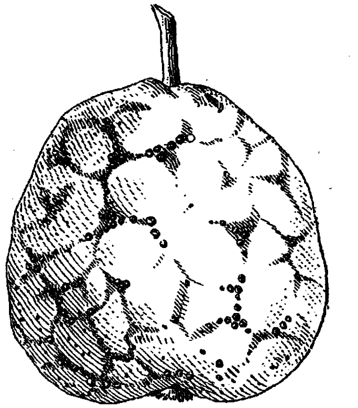


Figure 45.

[A very small scale infesting deciduous trees. Figures 44 and 45 represent a branch and fruit infested by the scale, popularly known as the San José scale.]

The margin of the ventral surface of the segment is deeply incised twice on each side of the meson; once between the bases of the first and second lobes and again laterad of the second lobe. On each side of each of these incisions is a club-shaped thickening of the body wall.

There are two inconspicuous simple *plates* between the median lobes, and on each side two similar plates extending caudad of the first incision, three small plates serrate on their lateral margin caudad of the second incision, and the club-shaped thickenings of the body wall bounding it, and three wide prolongations of the margin between the third and fourth spines. These prolongations are usually fringed on their distal margin. There are also in some, irregular prolongations of the margin between the fourth spine and the penultimate segment.

The first and second spines are situated laterad of the first and second lobes, respectively; the second spine laterad of second incision; and the fourth spine about half the distance from the first lobe to the penultimate segment.

Eggs.—The eggs are white.

Scale of Male.—The scale of the male is black, and is somewhat elongated when fully formed. The larval skin is covered with secretion; its position is marked by a nipple-like prominence, which is between the center and the anterior margin of the scale. The scale of the male is more abundant than that of the female.

Male.—The male has not yet been observed.

Habitat.—On apple, pear, plum, and other trees. Described from thirty females and very many scales of each sex.

From what I have seen of this very important pest, I think that it is the most pernicious scale insect known in this country; certainly I never saw another species so abundant as this is in certain orchards which I have visited. It infests all the deciduous fruits except the apricot and the Black Tartarian cherry. It attacks the bark of the trunk and limbs as well as the leaves and fruit. I have seen many plum and apple trees upon which all the fruit was so badly infested that it was unmarketable. In other instances I have seen the bark of all the small limbs completely covered by the scales. In such cases the wood beneath the bark is stained red.

Summer Remedy for Peaches.

Potash	14 pounds.
Caustic soda (98 per cent)	8 pounds.
Lime, unslacked	5 pounds.
Fish oil, polar or seal	10 gallons.

Directions.—First.—Dissolve the soda and potash by placing them together in about ten or twelve gallons of water.

Second.—Slack the lime in the barrel in two gallons of water; then add the fish oil to the lime and stir well until the lime and the oil have turned to a thick batter; then add the soda and potash, water, boiling hot, and stir well with a dasher for five minutes or more. Then leave standing for about four or six hours; then fill up with cold water; do not pour in all the water at once, but about two buckets at a time. Stir well as the first two buckets of water go in to prevent lumps. Use the following day. Apply cold, one pound to the gallon of water. In dissolving it do not boil, but weigh the amount to be used, place in a barrel, and on top of it pour hot water, about one bucket to every hundred pounds of material. After pouring in the hot water, stir lively with a dasher until it is entirely dissolved; then reduce with cold water until sufficiently thin enough to pass through the strainer; then place in the tank and fill up with water; stir well and it is ready for use; apply cold.

Summer Remedy for Pears and Apples.

Caustic soda (98 per cent)	10 pounds.
Potash	10 pounds.
Tallow	40 pounds.
Resin	40 pounds.

Directions.—First.—Dissolve the potash and soda in ten gallons of water. When dissolved, place the whole amount in the barrel (fifty-gallon measure).

Second.—Dissolve the tallow and resin together. When dissolved, add the same to the potash and soda in the barrel, and stir well for five minutes or so. Leave standing for about two hours, then fill up with water, stirring well as every bucket of water goes in. Use the following day, one pound to the gallon of water; apply warm.

For the winter two formulas are recommended, A and B. "A" does better in districts away from the coast, as there are no damp nights, fogs, etc., to affect its strength after being applied. "B" does better in the coast counties, or where fogs or damp nights prevail.

Winter Remedy (A).

Lime	25 pounds.
Sulphur	20 pounds.
Salt	15 pounds.

Directions.—Take ten pounds of the lime, twenty pounds of the sulphur, and twenty gallons of water. Boil until the sulphur is thoroughly dissolved. Take the remainder—fifteen pounds of lime and fifteen pounds of salt—slack, and add water to make the whole mixture sixty gallons. Mix the whole together, strain, and spray on the trees milk warm or warmer. This can only be applied when the foliage is off the tree; and has in this condition no injurious effect on the fruit buds or tree whatever.

Winter Remedy (B).

Unslacked lime	50 pounds.
French sulphur	20 pounds.
Salt	15 pounds.

Directions.—Place ten pounds of lime and twenty pounds of sulphur in a heater with twenty gallons of soft water. Boil for half an hour or more, until both lime and sulphur are dissolved. The sulphur must be thoroughly dissolved and mixed with the lime; the mixture will then be of an amber color. Next place in a cask or box forty pounds of good lime, and pour upon it enough soft hot water to thoroughly slacken the lime and keep it in a liquid form. After the lime is thoroughly slacked, add fifteen pounds of common stock salt while the material is hot. When the salt is well dissolved, mix the two lots together, with sufficient water to make sixty gallons of spraying material, which will then be a thin whitewash. The material should be strained after being thoroughly mixed—a good piece of burlap answering well for the purpose. Apply the mixture with a spray pump, using a rubber plate in the nozzle instead of the brass plate.

GREEDY SCALE.

Aspidiotus rapax, Comstock.

Scale of Female.—The scale of the female is very convex, with the exuviæ between the center and one side, covered with secretion. The scale is gray, somewhat transparent, so that it appears yellowish when it covers a living female; the prominence which covers the exuviæ is dark brown or black, usually with a central dot, and concentric ring, which are white. Ventral scale snowy white, usually entire. Diameter, 1½ mm. (.06 inch).

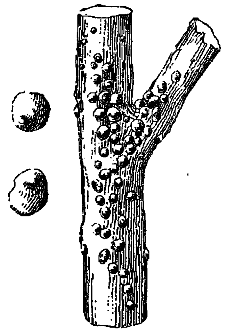


Figure 46.

[A small white scale infesting the pear and the apple. Found mostly on the Winter Nelis pear—on the fruit after having attained full growth. Resembles, in color and appearance, A. convexus and A. nerii.]

Female.—The body of the female is nearly circular in outline, bright yellow in color, with more or less translucent blotches. The last segment presents the following characters; the groups of *spinnerets* are wanting:

Only one pair of well developed *lobes* (the median) present. These are prominent. Each one is furnished with a notch on each side; the notch on the mesal margin is distad of that on the lateral margin. The second and third pairs of lobes are represented by the minute pointed projections of the margin of the body.

The margin of the ventral surface of the segment is deeply incised twice on each side of the meson; once lateral of the first lobe, and again between the rudimentary second and third lobes. The parts of the body wall forming the margin of these incisions are conspicuously thickened. There are two simple tapering *plates* between the median lobes, two deeply and irregularly toothed or branched plates extending caudad of each incision, one usually simple and tapering plate between the incisions of each side, and two or three of the same character laterad of the second incision.

The first, second, and third pairs of *spines* of each surface are situated near the lateral bases of the first, second, and third lobes, respectively; the fourth pair are situated at a little more than one half the distance from the median lobes to the penultimate segment. In each case the spine on the ventral surface is but little laterad of the one on the dorsal surface.

Eggs.—The eggs and newly hatched larvæ are yellow.

Male.—Only dead and shriveled males have been observed.

Habitat.—On the bark of the trunk and limbs, as well as the leaves and fruit of various trees and shrubs. Described from seventy-five females and very many scales.

I have named this the greedy scale insect, on account of the great number of plants upon which the species subsists. It also occurs in some localities in great numbers, being very destructive. This is especially the case on *Euonymus japonicus* and on the olive, and on mountain laurel (*Umbellularia californica*). I have also found it on the following named plants: almond, quince, fig, willow, eucalyptus, acacia, and locust.

Remedy.

This scale infests the apple and the pear, and is quite troublesome, as it gets on the fruit; however, it is not very injurious. Use the same remedies recommended for pernicious (*Aspidiotus perniciosus*) scale; this scale is of the same genus.

CONVEX OR WILLOW SCALE.

Aspidiotus convexus, Comstock.

This species, which is very common on the bark of the trunk and limbs of the native willows, very closely resembles *Aspidiotus rapax* in the shape and color of its scale. The resemblance of the two species is so great, that at first I considered them identical, and concluded that *A. rapax* had spread to the cultivated trees from the native willows. But a careful study of the structure of the two forms shows them to be specifically distinct. The most striking differences are those presented by the last abdominal segment of the female. In this species there are four groups of spinnerets, the superior laterals consisting of about seven, and the inferior laterals of about four. In *A. rapax* the groups of spinnerets are wanting.

In this species the plates are very much shorter than in *A. rapax*, and very closely resemble the plates in *A. ancylus*. But *A. convexus* differs greatly from *A. ancylus* in the shape and color of the scale, and in the wings of the male being long. Described from seven females, two males, and very many scales.

Remedy.

Use the same remedy for red scale (*A. aurantii*), when on evergreens, and the remedies for San José scale (*A. perniciosus*), on deciduous trees.

GENUS DIASPIS.

This genus includes species of Diaspinæ in which the scale of the female is more or less rounded, with the exuviæ at the center or upon the side; and the scale of the male long, white, carinated, and with the larval skin at one extremity. The last segment of the female presents five groups of spinnerets.

This genus closely resembles Aspidiotus in the form of the scale of the female, but it is easily distinguished from that genus by the form of the scale of the male.

JUNIPER SCALE.

Diaspis carueli, Targ.

Scale of Female.—The scale of the female is circular, snowy white, with the exuviæ central or nearly so, naked, and yellow. Diameter of the scale, 1 mm.-1.5 mm. (.04-.06 inch).

Female.—The females are yellow, circular in outline, a little elongated posteriorly. The last segment of the body presents the following characters:

The anterior group of *spinnerets* consists of about eight, the anterior laterals of from ten to sixteen, and the posterior laterals of about eight.

There are four *lobes*, which are nearly in a straight line, the end of the body being truncate. These lobes are quite small, rounded posteriorly and are equidistant from each other. The second lobe of each side is deeply incised, but the lateral lobule is very small, and in many cases concealed by the margin of the segment.

Each *lateral margin* of the segment is divided into three subequal more or less distinct lobes; each lobe ends posteriorly in one or two lobules, each of which bears an elongated pore on its dorsal surface.

The *plates* are short, and in some cases subtruncate at extremities; they are situated as follows: Two between median lobes; two inconspicuous ones laterad of first lobe of each side; two laterad of second lobe; usually one on the anterior part of the first lobe of the lateral margin; one or two near the middle of the second lobe of the lateral margin, and two or three on the third or anterior lobe of the lateral margin.

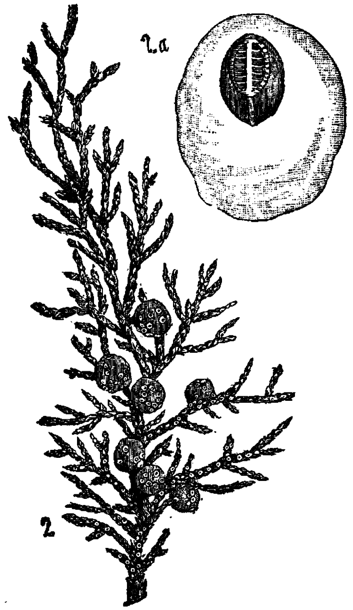


Figure 47.

[A small white scale, infesting the juniper. (2) An infested branch. (2a) The female scale. All highly magnified.]

The *spines* on the dorsal surface are situated as follows: One upon the first lobe near its lateral margin; one on lateral lobule of the second lobe; and one a short distance mesad of the mesal plate of each of the three lobes of the lateral margin. On the ventral surface the spine accompanying the first and second lobes of each side are obsolete. There is one at the base of the plate of the first lobe of the lateral margin; one between the plates of the second lobe, and one near the middle of the third or anterior lobe of the lateral margin.

Scale of Male.—The male scale is white, and very small, being only 1 mm. (.04 inch) in length; it is elongated, with a prominent median ridge; the larval skin is naked and light yellow in color.

Male.—The color of the body is light orange yellow, with the thoracic band of the same color. The terminal joints of the antennæ are enlarged.

Habitat.—This species is very common. It infests the following named species of juniper and arbor vitæ: *Juniperus chinensis*, *J. rigida*, *J. oxycedrus*, *J. japonica*, *J. communis*, *J. reresii*, *Biola oriemtalis*, and *Thuya occidentalis*.

Remedy.

The best remedy for this scale is the application of a strong solution of whale-oil soap, one pound to the gallon of water, applied warm.

ROSE SCALE.

Diaspis rosæ, Sandberg.

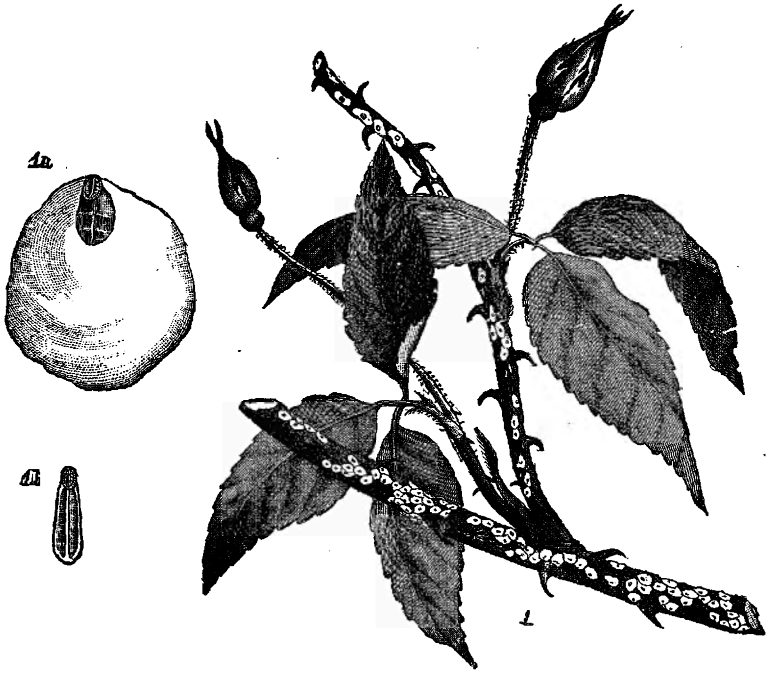


Figure 48.

[A small white scale, infesting rose bushes, blackberry and raspberry plants. (1) An infested branch. (1*a*) The female scale. (1*b*) Male scale. All highly magnified.]

Scale of Female.—The scale of the female is circular, snowy white (or, according to Signoret, yellowish white), with the exuviæ light yellow, and upon one side; the first skin is naked, the second usually covered with secretion. Diameter, 2 mm.–3 mm. (.08–.12 inch).

Female.—The female is elongated, resembling in form a Mytilaspis more than a Diaspis. The head and thorax comprise the larger part of the body. The abdomen is very distinctly segmented, especially upon the sides; each segment presents one or several plates, the two segments preceding the last a greater number, but usually less than ten. The last segment presents the following characters:

The groups of *spinnerets* are remarkable, from the fact that those of each side are often more or less continuous. Signoret stated that the anterior group alone is distinct; but in the majority of the specimens which I have studied the lateral groups are more or less distinct. The anterior group consists of about twenty spinnerets; the lateral group are of from twenty-five to thirty-five each. There are three pairs of *lobes*. The median lobes are large, slightly serrate, approximate at base, and diverging laterally. The second and third lobes of each side are deeply incised; the mesal lobule in each case is the larger.

The *plates* are long, slender, and simple. Those nearer the meson are smaller than those further removed from it; they are situated as follows: One arising from the base of the lateral margin of each of the three lobes of each side; one midway between the meson and the penultimate segment; two to four near the penultimate segment—there are commonly only two in this position, occasionally three, and sometimes four.

The *spines* on the dorsal surface are situated as follows: One very small one on each of the lobes; one on the outer lobule of each of the second and third lobes; one mesad of the fourth plate; and one between the two lateral plates. On the ventral surface there is situated a spine a little mesad of each of the first four dorsal spines.

Scale of Male.—The scale of the male resembles that of other species of Diaspis, in being long, tricarinated, white, and with the larval skin at one end; length, 1.25 mm. (.05 inch).

Male.—"The male is of a reddish white, with the wings white, the veins of the wings rosy; the venter is a little darker; the style equals the abdomen in length; antennæ and feet yellowish, slightly pubescent."—Signoret.

Specimens which we bred were bright orange, with the band of the same color, and the eyes black.

Habitat.—This species infests the bark of rose bushes, and on the bark of blackberry and raspberry canes.

Remedy.

This scale is quite troublesome, and is very common throughout this State, on rose bushes, blackberries, and raspberries. When blackberries and raspberries become badly infested, it is best to cut out and burn at once the old infested canes. The old infested wood of rose bushes can also be removed, without injury to the plant, and the balance of the bushes sprayed with a solution of strong whale-oil soap, one pound to the gallon of water, and applied warm. Strong caustic solutions injure the plants. The soap should be of the best. The raspberry and blackberry canes should be examined a few inches below the surface of the ground, this generally being loose, and thrown against the plants by the plow or cultivator, covers up part of the infested canes.

GENUS CHIONASPIS.

This genus includes species of Diaspinæ, in which the scale of the female is long, sometimes much widened, with the exuviæ at one extremity, and the scale of the male long, generally white, more or less carinated (except in *C. ortholobis*), with the sides parallel and the larval skin at the anterior end. The last segment of the female presents five groups of spinnerets.

This genus resembles Diaspis in the form of the scale of the male, and Mytilaspis in the form of the scale of the female; in most species, however, the scale of the female is wider than in Mytilaspis.

PINE SCALE.

Chionaspis pinifoliae, Fitch.

Scale of Female.—The scale of the female is snowy white in color, with the exuviæ light yellow; it is usually long and narrow; sometimes, however, it is broad. The shape of the scale apparently depends on that of the leaf to which it is attached. Thus on the broader leaved pines the broad scales are more common. Length of scale, about 3 mm. (.1 inch).

Female.—The body of the female is purplish red. The last segment presents the following characters:

The anterior group of *spinnerets* consists of from seven to ten, the anterior laterals of twelve to twenty, and the posterior laterals of fourteen to eighteen.

The median *lobes* are somewhat circular in outline, with their distal ends diverging slightly; there is an arched thickening of the body wall connecting the anterior ends of the lobes. The second and third lobes are each deeply incised; the mesal lobule is in each case the larger.

The *plates* are long, simple, tapering to a point; there is one laterad of each of the three lobes of each side, and one midway between the third lobe and the penultimate segment. There are elongated marginal pores in the following situations: One laterad of each of the first and second plates; one at the base of the mesal lobule of the third lobe; two between third and fourth plates; and two between the fourth plate and the penultimate segment.

The *spines* on the ventral surface are so delicate as to be almost invisible; their bases, however, are easily seen; they are situated one mesad of the base of each of the first, second, third, and fourth plates. The spines on the dorsal surface are quite long; the first is near the base of the first lobe, the second between the lobules of the second lobe, the third on lateral lobule of third lobe, and the fourth a short distance mesad of the fourth plate.

Scale of Male.—The scale of the male is white and carinated, as with other species of this genus.

Male.—The male is a uniform orange red; eyes black.

Habitat.—On various species of pine and spruce.

Remedy.

This scale is not very troublesome. It can be easily kept in subjection by the application of strong tobacco water, or a solution of whale-oil soap, one pound to the gallon of water.

OAK SCALE.

Chionaspis quercus, Comstock.

Scale of Female.—The scale of the female is long, narrow at the anterior end, much widened posteriorly, and quite convex. The exuviæ are brownish yellow; the secretion, of which the remainder of the scale in composed, is white; but all of my specimens appear dark gray, being more or less covered with the hairs of the stem to which the scale was attached, and with dust. Length of scale, 2 mm. (.08 inch).

Female.—The last segment of the female presents the following characters: The anterior group of *spinnerets* consists of about ten, the anterior laterals of seventeen to twenty, and the posterior lateral of ten to eighteen.

This species differs from all Diaspinæ known to me in having a single undivided *lobe* on the meson; this lobe is large and rounded distally. The second and third lobes of each side are very small and are laterad of small incisions in the margin of the segment. In each case there is a reniform thickening of the body wall bounding each incision anteriorly. There is also a similar incision with a rudimentary lobe and reniform thickening of the body wall about midway between third lobe and penultimate segment.

The *plates* are inconspicuous and spine-like; there are usually one or two laterad of second ventral spine, two or three between third and fourth lobe, and usually five between fourth lobe and penultimate segment. The penultimate and antepenultimate segments bear six each; those on the latter are much expanded at the base.

The spines are long and conspicuous; those on the dorsal surface are situated as follows: One on each side at the base of the lateral margin of median lobe, one laterad of each of the second and third lobes, and a fourth one near the center of the anterior group of plates. Those on the ventral surface are as follows: A short one nearly ventrad of the first dorsal spine, a large one laterad of each of the second and third dorsal spines, and a fourth one a little cephalad of the fourth dorsal spine.

Scale of the Male.—The scale of the male is snowy white, with the larval skin very light yellow. The texture of the scale is quite loose and the carinæ prominent. Length, 1.25 mm. (.05 inch).

Male.—The adult male is as yet unknown; many pupæ were collected August 17, 1880. Specimens of these mounted in balsam are bright yellow in color, with eyes purplish black. Fully grown male larvæ in balsam are yellowish brown.

Habitat.—On white oak (*Quercus lobata*) in San Fernando Valley. The females occur on the bark of the small limbs; the males upon the leaves. Described from four scales of the female, hundreds of scales of the male, and many male pupæ and larvæ.

Remedy.

This scale infests several species of oak. The oaks can stand a stronger application of caustic solutions than most trees. One strong application of kerosene emulsion will also keep the scale in check for a number of years, prepared as follows:

Kerosene oil (best), 150 degrees test	5 gallons.
Whale-oil or laundry soap	2 pounds.
Water	2 gallons.

Dissolve the soap in the water, and add the kerosene, and churn with a dasher, or pass through the force pump until emulsified. When using, dilute one gallon of emulsion in six gallons of water; apply warm.

GENUS MYTILASPIS.

This genus includes the species of Diaspinæ, in which the scale is long, narrow, more or less curved, and with the exuviæ at the anterior extremity. The scale of the male resembles that of the female in form; but it can be readily distinguished by its small size, and by bearing only one larval skin.

In all the species of Mytilaspis which I have studied, the posterior part (about one fourth) of the scale of the male is joined to the remainder by a thin partition which serves as a hinge, allowing the posterior part to be lifted when the male emerges.

PURPLE SCALE.

Mytilaspis citricola, Packard.

Scale of Female.—The scale of the female is long, more or less curved and widened posteriorly. It is brown, with the exuviæ of the same color, and with a delicate margin. The ventral scale is well developed; it is

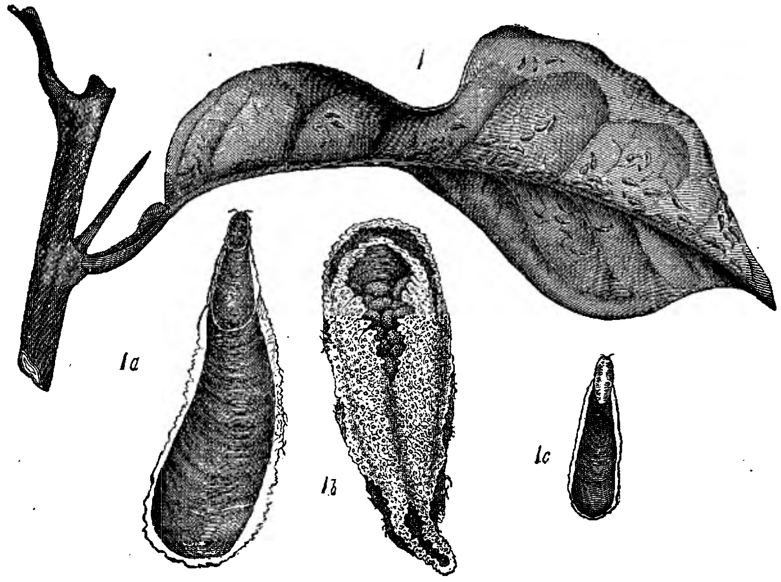


Figure 49.

[A purple scale generally found on imported lemons in our markets. As yet it does not infest trees in this State. Resembles *Mytilaspis pomorum* (oyster-shell apple scale), which is common in many places on old apple trees. In Florida it is a troublesome pest. (1) Twig and leaf infested by the scales. (1*a*) Scale of female from above. (1*b*) Same from below, showing eggs. (1*c*) Scale of male. All highly magnified.]

white, and consists of a single piece which is slightly attached at its sides to the lower edge of the scale, and is more or less incomplete posteriorly. Length of scale, 3 mm. (.12 inch).

Female.—The female is yellowish white. The characters of the last segment are as follows:

The anterior group of *spinnerets* consists of about six, the anterior laterals of about eighteen, and the posterior laterals of about nine.

The median *lobes* are well developed with the margins crenate; the second lobe deeply incised, with the margins of the lobules either entire or crenate; the third lobe is quite inconspicuous, projecting but little beyond the body wall; the margin crenate and one large notch in the center of the lobe.

The *plates* are long, simple, and tapering. There are two of them in each of the following places: Between median lobes; between first and second lobes; between second and third lobes; laterad of third lobe; and about midway between this lobe and the penultimate segment. There is an elongated pore between the first and second lobes; two laterad of each of the third and fourth pairs of plates; and one laterad of the fifth pair of plates. The penultimate segment bears at least four plates upon each lateral margin.

The *spines* upon the dorsal surface are long, and are situated as follows: One at the base of each margin of the first lobe; one dorsad of incision of second lobe; one dorsad of the notch of third lobe; and one about midway between the fourth and fifth pairs of plates. Those of the ventral surface are as follows: Cephalad of the bases of the first pair of plates are two small spots, which resemble the base of spines, and are, doubtless, the

homologues of the first pair; the second spine of each side is near the base of the lateral half of the first lobe; third spine laterad of lateral lobule of second lobe, and fourth and fifth spines between the members of the fourth and fifth pairs of plates, respectively.

Eggs.—The eggs are white, and are arranged irregularly under the scale.

Scale of Male.—The scale of the male is usually straight, or nearly so; the same color as that of the female, or in some specimens varying to a very dark brown, almost black; the larval skin light yellow. At about one quarter of the length of the scale from the posterior extremity the scale is thin, forming a hinge, which allows the posterior part of it to be lifted by the male as he emerges. Length, 1.5 mm. (.06 inch).

Development of the Insect and Formation of the Scale.—Upon March 15, 1880, observations were commenced upon a brood of young lice just hatching. Their color was white, yellowish at both ends, and with red eyes; antennæ, six-jointed; margin of the head as far as the eyes, tubercled, and each segment of the abdomen with a lateral piliferous tubercle. When placed upon a young orange tree, all settled in from fifteen to twenty minutes. Twenty-four hours later no change had taken place, except that the cottony excretion referred to in the general remarks was already observable at the posterior end of the body. Forty-eight hours from the time of hatching the cottony mass had increased to such an extent that only the anterior fourth of the larva could be seen. The secretion was dense and compact, and a few long, very fine, rather curly threads of a yellowish color protruded from it. Each side of the head a fine curl of the cottony substance extended forward, and from the frontal border of the head filaments of the same extended at equal distances. At seventy-two hours the dense excretion had covered the eyes. Behind the head, in most specimens, there was a marked constriction in the covering, which in some, however, was but slightly indicated.

From this period up to the age of ten days the alteration was but slight. The covering had increased so as to extend beyond the head of the insect. Removing the covering, it was noticed that nearly all trace of the segmentation of the abdomen was gone, and that it was oval in form.

Upon abdominal joints 1, 2, 3, and 4, four rows (two dorsal and two lateral) of pale, transparent spots were noticed. From this time (March twenty-fifth) on, until April sixth, the changes in the body of the insect were very slight. The skin was gradually separating from the body within, and toward the latter part of this period the abdominal outline of the latter, with its notches, could be plainly seen through the first larval skin. April sixth, or twenty-two days from hatching, the larvæ molted their first skin. In preparation for this act, they worked their way partly out of their excreted cases, sometimes destroying the anterior end in the effort. In the act of molting, the skin splits ventro-transversely between the thorax and the abdomen, and the abdomen is first drawn forward and thrust through the aperture. How the remainder of the body is disengaged is not precisely known—whether it is drawn down through the same split, or whether the anterior part of the old skin has a longitudinal ventral split; but the latter is probably the case. The color of the insect after this first molt is white, with pale orange eyes, and a tinge of yellow to the proboscis, to the alimentary canal, and to the end of the body. Great irregularity was noticed in the time of shedding of the skin, some finishing two weeks before others; and after the molt was completed, some were covered entirely and hidden from view by the cast-off skin and waxy secretion, while others were partly exposed. The old covering began to melt gradually, and the new scale began to form at the posterior end of the body, at first resembling compact scum or froth; and six days after the molt it was already from three to four times the size of the shed skin which adheres to the outside of the forming scale, covered, as to its anterior half, by the remains of the woolly secretion of first stage.

From this time on till forty days from the time of hatching, the scale grew gradually, as also the inclosed insect, the former at this time changing from white to yellowish brown, having precisely the appearance of the full grown scale, except as to size. At forty-four days after hatching, the scales were about one fourth the size of the full grown; at forty-six days it was observed that the male larvæ were rapidly maturing, and that already traces of antennæ and legs were to be seen. At fifty-four days the more advanced individuals shed the second skin and appeared as pupæ; about the same time the females also cast their second skin. Our notes do not show the exact length of time which the males remained in the pupa state, but that it is very short is shown by the fact that on May eighteenth pupæ from eggs hatched March thirtieth were observed to transform to adults, the old pupa skin being pushed backward out of the scale. The description of the adults of both sexes has already been given.

At eighty days the females were observed to have deposited eggs, and already the young had begun to hatch. Later in the season the development is more rapid than that just detailed. From eggs which hatched May twenty-second, males were reared June twenty-fifth, a space of thirty-four days, while the females of the same generation had begun to oviposit July twelfth, or fifty-one days from hatching.

Habitat.—This is one of the two most common species of scale insects found on citrus trees in Florida. It is probably a European species, as I have frequently found it on imported oranges in our markets. It also occurs in Louisiana. Mr. Glover states (Report Department of Agriculture, 1855, p. 119) that this species was imported into Jacksonville, Florida, in 1855, on some lemons sent from Bermuda.

NOTE.—This scale as yet is not known in this State. The descriptions and illustrations are added to the list to show the danger of their importation and introduction into our groves.

THE LONG OR GLOVER'S SCALE.

Mytilaspis gloverii, Packard.

The Scale of Female.—The scale of the female in this species differs from that of *M. citricola*, with which it is often associated, in being much narrower. Color, light yellow, varying to dark brown; the ventral scale is white, and consists of two long, narrow parallel plates, between which is an open space.

Female.—The body of the female is light purple in color, with the last segment yellowish. This segment presents the following characters:

The anterior group of *spinnerets* consists of five, the anterior laterals of about eleven, and the posterior laterals of five.

The margin of the segment is the same as in *M. citricola*, with the following exceptions: The first lobe on each side is abruptly narrow, then prolonged more or less into a point, with the margins scarcely serrate; lobules of second lobe longer and narrower.

The *spines* are very small; the ventral one of the median lobe invisible. There are only two plates on the penultimate segment.

Eggs.—The eggs are white when first laid, but become tinged with purple before hatching. They are arranged in two rows in a very regular manner.

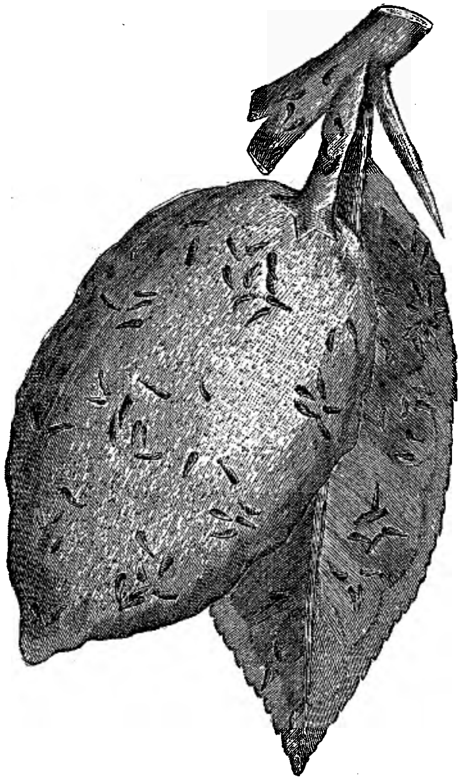


Figure 51.

[Figure 51 shows a lemon as seen in our markets infested by *Mytilaspis gloverii*.]

Scale of Male.—The scale of the male is similar in form to that of the female, except that there is but a single molted skin, and the scale is furnished with a hinge like that described under head of *M. citricola*.

Development of the Insect and Formation of the Scale.—Our observations show that the development of Glover's scale is, up to a certain point, almost parallel with that of *M. citricola*, and that its failure at that point may be abnormal will be seen from what follows:

March twenty-seventh, eggs under observation began to hatch. The young larvæ are purplish, with the front of the head and the margin of the body yellowish. Most of them settled almost immediately, and at two days the cottony excretion had covered one half the insect. At four days it reached beyond the eyes, and the larva itself seemed to be more elongated, with the joints more distinct. At six days most of them were entirely covered, with the excretion extending like two horns at each side of the head. With some there were only two or three transverse constrictions of the covering, giving them a very peculiar appearance. At seven days the future dentate appearance of the abdomen could already be detected through the skin, and at eleven, several presented every appearance of a speedy molt, having pushed themselves forward from the covering. They remained in this state, however, without marked change, except that some secreted a tuft of the waxy threads, which rose erect for two or three times the length of the scale, for twelve days more before shedding their first skin, which was done at the age of twenty-three days. The molt was performed in precisely the same manner as with Citricola. Immediately after the molt the whitish permanent scale began to form. At thirty-two days one could begin to distinguish the legs and antennæ of the future pupæ in the males. At forty-four days the first female was observed to have cast its second skin; the color after the molt is white, with the anal segment and middle of the body yellowish. About the same time the males became pupæ, and at forty-five days the first adult male was found. From this time up to the age of one hundred and two days the female scales were watched daily, but no eggs were observed. At this age all either died or were mounted, so the age at which the eggs are deposited has not been determined. It may be that the non-development in this case was due to the fact that the females had not been fertilized.

Habitat.—This is a very common species on citrus trees in Florida and Louisiana. It infests the fruit, leaves, and bark of the trees, and is usually associated with *M. citricola*. It is supposed that it was introduced into Florida about forty years ago by Mr. H. B. Robinson, who owned a grove at Mandarin. Mr. Robinson is said to have purchased two trees in New York from a ship from China. From these trees the insect is said to have spread.

Trees which this department received from Europe were badly infested by this scale insect. This, however, does not prove the European origin of the pest, as it may have been carried there from China.

NOTE.—This scale, like the preceding one, has not yet made its appearance in this State. Lemons, however, arrive in our market, and great care should be taken that no lemons infested with these scales ever be taken where citrus fruits are grown, even after having been disinfected, as many of the insects escape the effects of the solution.

OYSTER-SHELL APPLE SCALE.

Mytilaspis pomorum, Bouche.

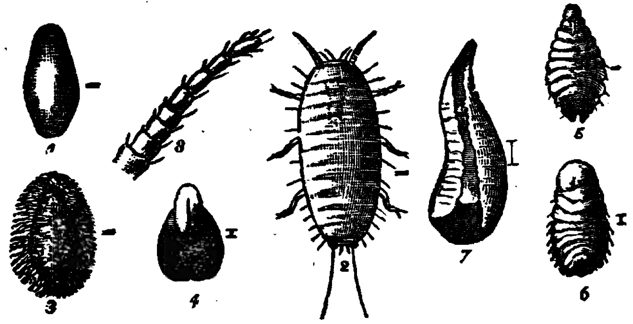


Figure 52.

Figure 53.

[A brown oyster shaped scale infesting the apple and pear. Found mostly on old trees. It resembles somewhat *Mytilaspis citricola*, in general appearance. Figure 53 shows the scale on the bark. Figure 52: 1. Egg; 2. Young insect (larva); 3. Appearance of secretion as it hardens and forms shell over body of insect; 4. A form of the scale before it reaches maturity; 5 and 6. Appearance of insect after casting skin, limbs, and other appendages; 7. Scales (cover) at maturity; 8. Antennæ. All of these figures highly magnified.]

Scale of Female.—The scale of the female is long, narrow, widened posteriorly, more or less curved, of an ashy gray color, with the exuviæ yellowish. Length, 2 mm. (.08 inch).

Female.—The body of the female is yellowish white. The last segment presents the following characters:

The anterior group of *spinnerets* consists of from eleven to seventeen; the anterior laterals and posterior laterals each of sixteen to twenty-one.

The median lobes are large and wide, with the sides parallel; they are only about three fourths as long as broad; each lobe is narrowed on each side near the distal extremity by one or two notches, and then rounded. The second lobe of each side is about as wide as the first, and is deeply incised; mesal lobule with mesal margin as long as lateral margin of the first lobe, and rounded posteriorly; lateral lobule about half the length and width of mesal lobule and similar in shape. Third lobule obsolete.

The *plates* are arranged as in *M. citricola;* the lateral members of the second and third pairs are shorter and smaller than the mesal. The penultimate segment bears two pairs on each side.

The *spines* are as in *M. citricola*, except that the first dorsal pair are not so conspicuous.

Scale of Male.—The scale of the male of this species closely resembles those of *M. gloverii* and *M. citricola*, being much smaller than that of the female, straight, or nearly so, with a single molted skin, and with the posterior part joined to the remainder of the scale by a thin portion which serves as a hinge.

Male.—I have not bred the male from apple. Its color is described by Mr. Riley as being translucent, corneous gray with a dorsal transverse band on each joint, and the portions of the mesothorax and metathorax darker or purple gray, and with the members somewhat lighter.

Habitat.—This is an imported European species, which is common throughout the greater part of those sections of the United States where apples are grown to any great extent. It is, however, much more common in the cooler parts of the country, being replaced to a certain extent by *Chionaspis furfurus* in the warmer sections.

There is but a single generation of this insect each year in the north, where the eggs hatch in the latter part of May, or early in June, and two generations in the south.

This species is said to infest many different plants, but in nearly, if not every case, the opinion respecting the specific identity of the forms occurring on other plants with that upon the apple has been based upon the characters presented by the scale. These characters being insufficient to distinguish this species from closely allied forms, it is very desirable to confirm these observations. I have, however, found about twenty different species of plants infested by one or more species of Mytilaspis, which, after the most careful study of structural characters, I am unable to distinguish from *M. pomorum*. If the greater part of these plants and trees which are infested, is *M. pomorum*, it is a very remarkable fact that, notwithstanding the abundance of it on these trees, apple trees growing in the immediate vicinity are not infested, and, too, although the male of *M. pomorum* is rare on apple, it is not at all so on the other plants. The following is a list of the plants upon which I have found this form of Mytilaspis: Linden, hop tree, bladdernut, horse chestnut, maple, an exotic amorpha, water locust, raspberry, hawthorn, currant, *Ribes alpenum*, *Lonicera pulverulenta*, ash, elm, hackberry, *Planera kakii*, willow, poplar, and Yucca.

Remedy.

This scale is somewhat difficult to destroy. The remedies used against the Pernicious (*Aspidiotus perniciosus*) scale are effective on this scale. (See remedies.)

SUBFAMILY LECANINÆ. GENUS CEROPLASTES.

The species belonging to this genus are furnished with a thick covering of waxy material, which does not, however, adhere closely to the insect. This covering is formed of layers secreted by the spinnerets. Some of the species have tuberosities upon the back, which are larger or smaller according to the age of the insect, and which entirely disappear at full growth, when, from being more or less flat with tuberosities or nuclei with concentric lines, they become smooth and globular. The antennæ are six-jointed, the third being the longest. (In the larva state the fourth and fifth appear as one.) The legs are long. The claw is furnished with four digitules, of which the two shortest are very large and horn-shaped. The male of this genus is not known.

FLORIDA WAX SCALE.

Ceroplastes floridensis, Comstock.

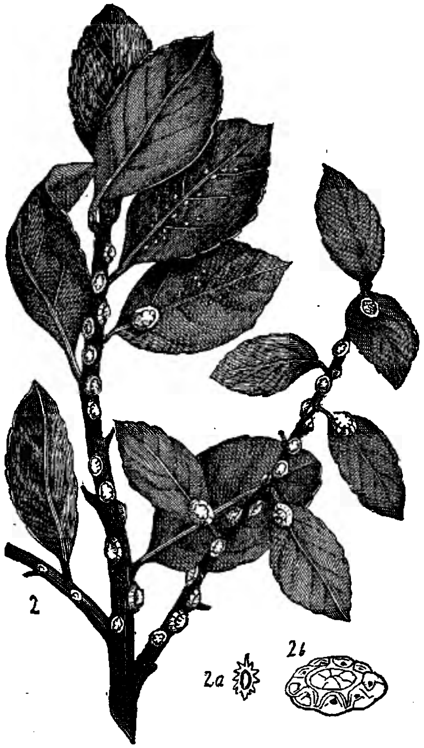


Figure 54.

[A white scale which appears in and throughout Florida. Has not yet made its appearance in this State, and care should be exercised to prevent its introduction; and in order that parties importing trees or plants may be able to identify it, this description and illustration is given. Figure 54 represents a branch infested with the scale. (2a) Young female. (2b) Adult female, enlarged.]

Adult Female.—Subglobular in form, the point of attachment to the twig or leaf being concave. Length, from 2.5 mm. to 3 mm.; color, when naked, reddish brown; covered with an apparently homogeneous layer of waxy excretion, which is usually brownish on the dorsum and dirty white towards the edges; some specimens are irregularly mottled, brownish, and yellow-white. Antennæ; six-jointed; joint three nearly as long as all the others together; legs normal in all respects. The margin of the body in the region of the stigmata is furnished with groups of minute, arrow-shaped tubercules, constriated at the base, and between these groups are bristle-shaped spinnerets. (We doubt whether these arrow-shaped tubercules will prove of specific value, but they are only mentioned by Signoret in two species, *C. vinsonii* and *C. fairmairii*—in the former case accompanied by the bristles, in the latter without them.)

Eggs.—Ellipsoidal in form, 0.25 mm. long, and about half as wide; color, light reddish brown.

The Newly-hatched Larva.—Moderately slender; antennæ six-jointed; joint six furnished with a number of very long hairs; tarsi as long as tibiæ. The two digitules of the claw are slender and but slightly expanded at the tip; of the two tarsal digitules, the distal one is very short and slender and with but a very slight expansion, while the proximal is long and stout and has the normal appearance. The two bristles of the precaudal lobes are very long, while those of the caudal lobes are very short. The color is light reddish brown, with slightly paler legs and antennæ.

Growth of the Insect.—The young lice are very active, and upon hatching spread at once in all directions, settling usually in from one half to three quarters of an hour, and usually upon the upper surface of the leaf, near the mid-rib. While engaged in inserting the probosis into the leaf, the legs and antennæ are all in motion; but once fixed, they are all drawn under the body, and the insect appears motionless and memberless. At two days after hatching, two parallel dorsal ridges of white secretion, meeting in front and behind, and dentate along the inner edges, made their appearance. At three days these ridges were plainer, divided transversely at the middle, and some of the inner dentations had grown so as to touch those of the opposite side. Around the sub-dorsal portion were bits of white secretion, apparently eight on each side, one behind each eye, and a larger one between the eyes. At five days the sub-dorsal spots had increased in size, especially the one between the eyes, and the first, second, and fourth thoracic pairs, and the seventh and eighth abdominal pairs. (There are now seen to be four thoracic and eight abdominal pairs of these spots, in addition to the large one between the eyes.) The dorsal secretion at this time forms almost two compact masses, leaving only a very narrow line, through which the body is still to be seen. At six days the dorsal secretion had become entirely united, and the tufts, as we may now call them, increased in length, the first abdominal pair being shortest, and the others towards the anal end gradually increasing in size. At nineteen days the dorsal secretion had formed a compact oval mass, and there were fifteen distinct lateral tufts to be seen—seven on each side and one at the point. At this stage all the specimens which we have attempted to rear have died. Many lived for months without perceptible change, and the conditions are probably not favorable for the production of further secretion or for the change of the white tufts into the waxy plates which are seen in the next stage of growth.

When the insect has attained a length of from 1.5 mm. to 2 mm., it is found to be covered with nine irregulate waxy plates, the central one very small and the six lateral ones larger, of an irregular oval in shape, while the cephalic and caudal ones are triangular, the apex of the triangle towards the central plate. Near the center of each of these plates is usually a small bit of white secretion (usually larger with the central plate than any other). The plates are, even at this time, not well differentiated, and, with the increase of the insect in size, the dividing lines become lost, the lateral plates extend over the central, until at full growth the wax presents the appearance of a continuous even covering. At any time previous to full growth, after the plates have been formed, if the waxy shield be removed, six very large prominences will be observed, three on each side of the insect, corresponding to the six original lateral plates. As the body fills with eggs and expands, these tuberosities grow less perceptible, until in the old female they are not to be seen at all.

The half-grown specimens are usually dirty yellowish white in color, often tinted with pinkish or reddish brown.

Food Plants.—While the principal economic importance of this species is derived from the fact that it is found upon all the different citrus plants in different parts of Florida, yet it is also found upon fig, pomegranate, guava, quince, and Japan plum (*Biotrites japonica*). I have also found it upon red bay, oleander, sweet bay, very abundantly upon the gall berry (*Ilex glaber*), upon the common myrtle, and upon an ericaceous plant belonging to the genus *Andromeda*.

Synonymical.—This species is treated under the name of *Ceroplastes rusci*, Linn., by Mr. Ashmead in his "Orange Insects," and what is probably the same insect was similarly identified by Professor Riley in the Department of Agriculture report for 1878, page 208. Compared with *C. rusci*, however, *C. floridensis* presents several marked differences, the most easily noticeable being the small size of the central plate, and its entire disappearance so early in the life of the insect. With *C. rusci*, according to the figures of Targioni and Signoret, the central plate is much larger than any of the others, and continues so as long as any dividing lines can be observed.

From the specific name which I have given this insect, it will be seen that I consider it indigenous. I found it common in all parts of Florida which I visited, even upon the pine barrens many miles from any orange grove. Moreover, I have always found it more abundant upon the gall berry than upon the orange or any cultivated plant. Mr. Ashmead considers it as imported, but his specific identification has undoubtedly misled him.

The orange growers cannot expect to free their groves from this insect so long as the gall berry grows about them as abundantly as it does in some places. I have always found those bushes growing in wet places more extensively infested than others.

FLORIDA BARNACLE SCALE.

Ceroplastes cirropediformis, Comstock.

Adult Female.—Average length 5 mm.; width, 4 mm.; height, 4 mm. When naked the color is dark reddish brown; the shape subglobular, with a strong spine-like projection at the anal end of the body. The waxy covering is dirty white, mottled with several shades of grayish or light brown, and even in the oldest specimens retains the division into plates, although the form is more rounded, and the dividing lines by no means as distinct as at an earlier age. There are visible a large convex dorsal plate, and apparently six laterals, each with a certain nucleus; the anal plate however, is larger, and shows two nuclei, and is evidently two plates joined together. Antennæ six-jointed, and proportioned as with *C. floridensis*. Legs long; tibiae nearly twice as long as tarsi; digitules of the claw very large. The other tarsal pair very long and slender, but with a very large button. The skin is seen in places to be furnished with many minute, round, transparent cellules, probably *spinnerets* (indicated and so called by Signoret in his description of *C. vinsonii*), and along the border are small groups of the constricted arrow-shaped tubercles mentioned in the last species; but the bristle-shape *spinnerets* seem to be wanting, as in *C. fairmairii*, Targ.

The Eggs.—Length 0.35 mm., rather slender, little more than a third as thick as long. Color light reddish brown, rather darker than the eggs of *C. floridensis*.

Growth of the Insect.—The growth of the insect and the formation of the waxy covering seems to be very similar to that of the last species. Soon after the larva settles the same two dorsal ridges of white secretion make their appearance, but soon split up into transverse bands. Examined on the fifth day after hatching a larva showed seven distinct transverse bands, the anterior one being in the shape of a horseshoe. At the same time the lateral margin of the body was observed to be fringed with stiff spines, seventeen to a side. At nine days the small horseshoe-like mass had extended so as to nearly cover the thorax, and the transverse bands had lengthened and widened until they presented the appearance of a nearly complete shield to the abdomen, serrate at the edges. Fifteen lateral tufts, such as were noticed in *C. floridensis*, and such as Targioni figures in the larva of *C. rusci*, had appeared, though still small.

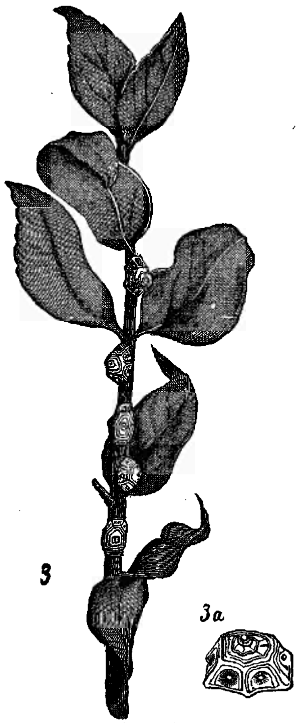


Figure 55.

[A small barnacle-like scale found throughout Florida. The reasons given for the publication and description of the preceding species apply to this scale. Figure 55 represents a branch infected with the scales; (3a) female, enlarged.]

At this stage of growth, as with the last species, all development seemed to stop, although the specimens lived on for months, the temperature in the breeding house probably not being favorable to the formation of the plates.

The smallest specimen in the collection with the plates already formed, measures 2 mm. long, by 2 mm. wide, and 1 mm. high. The color is light brown and the wax has a somewhat translucent appearance. The dorsal plate is seven-sided; it is truncate anteriorly and pointed posteriorly. From each angle radiates a suture to the lateral edge, thus forming seven lateral plates, of which a single one is above the head, while above the anus is the suture between two. Through this suture projects the anal spur. Each plate has a dark brown patch in its center, and in the center of each brown patch is a bit of the white secretion.

Habitat and Food Plants.—Found in Florida, on orange, quince, and on a species of *Eupatorium*, often in company with *C. floridensis*, although it was by no means so common a species.

GENUS PULVINARIA.

The genus Pulvinaria is not well defined. It was erected for those species of Lecaninæ, in which the females after fecundation secrete below and at the posterior end of the body a mass of cottony material which forms a nidus for the eggs.

But one species has been described in this country—the *Pulvinaria innumerabilis*, of Rathvon, a very abundant species in many localities upon the maples.

COTTONY MAPLE SCALE.

Pulvinaria innumerabilis, Rathvon.

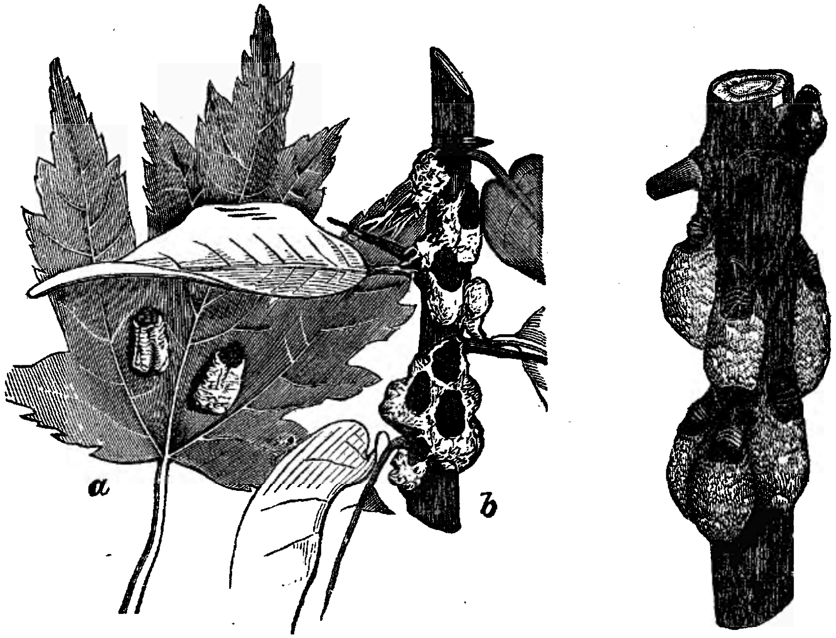


Figure 56.

[A white cottony scale (Figure 56), which infests the maple, and has also been found on the grapevine, and on the osage orange. (*a*) Shows the scale on the maple leaf. (*b*) Shows the scale on the branch of the osage orange. The figure to the right shows the scale on grapevine.]

This scale insect (Figure 56) somewhat resembles the cottony cushion scale (*Icerya purchasi*), but can be easily distinguished, being much smaller and the general appearance differing materially. The female is oval in form, color dark brown; near the posterior end are ridges, and the lines that separate them are darker than the other parts. The eggs are laid in the cottony sac; they are white when first laid, but change to a yellowish tinge before hatching. They are oval in form. The larva is yellowish white.

Remedy.

This scale is seldom met with. There is a species of black ant that destroys its egg sac, and on that account it does not increase. Being a soft shell scale, the hot sun also kills many of the insects. During the time the vines are dormant—in the winter—the prunings are carefully gathered and burned. The body of the vine is then sprayed with a solution of whale-oil soap, one pound to the gallon of water, and applied warm.

CAMELLIA SCALE.

Pulvinaria camellicola, Signoret.

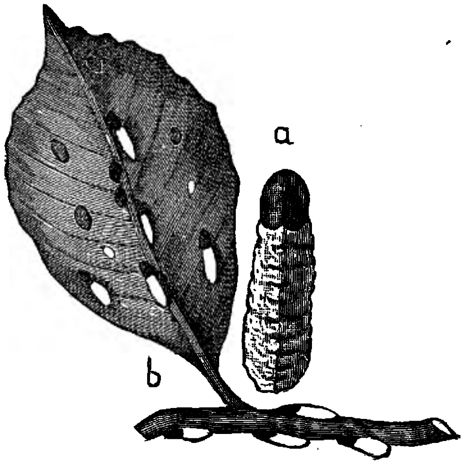


Figure 57.

[A cottony-like insect infesting the Camellia Japonica. (*a*) One of the scales. (*b*) An infested limb and leaf, showing the scales thereon.]

According to Maskell, the adult female is yellowish or reddish brown, naked, slightly convex, elongated; skin smooth, with puncta; length variable, from about one seventh of an inch to one ninth of an inch. Antennæ (according to Signoret) with sometimes six, sometimes seven joints. Abdominal cleft and lobes normal. The insect excretes a narrow, white, cylindrical, cottony ovisac, which is conspicuous on the leaf of the plant, and the brown body of the female can be seen at one end of it. The eggs in this ovisac are numerous, perhaps some hundreds. Larvæ and second stage of female flat, oval, yellowish brown.

Male pupa covered with a waxy, elongated test, as in the genus *Ctenochiton*, but there is no fringe, and the segments of the test are not conspicuous; the test is oval and convex.

Adult male yellowish gray, the head rounded, with an anterior protuberance. Two dorsal and two ventral eyes, and two ocelli. Antennæ of ten joints, all hairy. Feet exhibiting only two digitules, the upper pair. Abdominal spike short, with two longish setæ on each side, each pair of which are covered with cotton, which is produced into a long, white, conspicuous cauda.

Habitat.—On camellias; those in the open air are much subject to it.

The female of this species is not unlike *Lecanium hesperidum*, but the formation of the white ovisac is a clearly distinguishing character. In late summer the female often drops off to the ground, leaving only the ovisac observable on the leaf.

Remedy.

Wash the plants with a strong solution of tobacco water, which must be washed off about an hour after it is applied with cold water.

HEMISPHÆRICAL SCALE.

Lecanium hemisphæricum, Targioni.

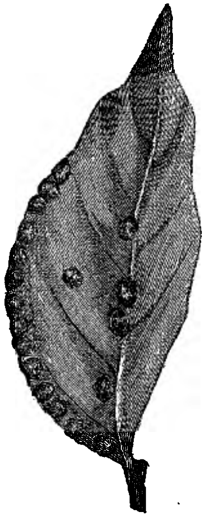


Figure 58.

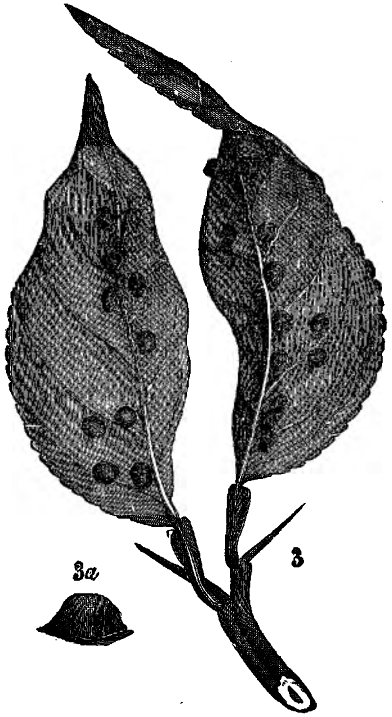


Figure 59.

[A dark brown hemispherical scale, which infests citrus and ornamental trees, but mostly the lime and the filbert. They settle on the limb and on the mid-rib of the leaf, but mostly along the margin, as shown in Figure 58. Figure 59 (3), a branch and leaves infested by the scales; (3*a*) adult female—enlarged.]

Adult Female.—Shape approaching hemispherical, with the edges flattened. Average length, 3.5 mm.; width, 3 mm.; height, 2 mm. The shape and proportions vary somewhat, according as the scale is formed upon a leaf or a twig. Upon the rounded twig it loses something of its hemispherical form, becomes more elongated, and its flattened edges are bent downwards, clasping the twig. In such cases, of course, its height becomes greater and its width less. The color varies from a very light brown when young to a dark brown, occasionally slightly tinged with reddish, when old. The oval cells of the skin vary in length from .01 mm. to .04 mm., and each cell contains a large granular nucleus. The antennæ are eight-jointed, with joints one and two short and thick; joint three is the longest, and the succeeding joints decrease gradually in length to joint eight, which is longer than the preceding. Occasionally a specimen is found in which joint five is longer than four, and I have seen individuals in which this was the case with one of the antennæ while the other was normal. The legs are long and rather slender. The bristle on the trochanter is long. The articulation of the tarsi is very well marked. (This fact was suggested to Signoret, that the insects of this series are less fixed than their congeners.) The tarsal digitules are as usual two long and two short; those of the claws spreading widely at summit and very stout at the base. The anal-genital ring (more easily seen than in the other species we described) is furnished with eight long hairs. The anal plates are triangular, with rounded corners, and are furnished with two long hairs upon the disk and three much shorter ones at the tip.

The Eggs.—The egg is ellipsoidal in form and 0.15 mm. in length. In color it is whitish, with a yellowish tinge, and is smooth and shiny.

The Newly-hatched Larva.—The antennæ are only seven-jointed, and the tarso-tibial articulation is hardly marked.

Actual observation shows the surmise of Signoret as to the locomotive powers of this insect to have been correct. We have seen the adult insects when removed from their positions crawl back with apparent ease.

Remedy.

This scale insect infests the lime tree mostly. The best remedy is the kerosene emulsion, prepared as follows:

Five gallons best kerosene oil, 150 degrees test; one and a fourth pounds good common soap, or one bar and a half of soap usually sold as pound packages; two and a half gallons of water. This makes the emulsion. When using, dilute six and one half to seven gallons of water for each gallon of oil, and to this mixture add two and a half pounds of good home made soap, dissolved in boiling water. All this mixing is done with hot water, and is applied at a temperature of 140 degrees Fahrenheit.

BROWN OR SOFT ORANGE SCALE.

Lacanium hesperidum, Linn.

Adult Female.—Length, 3 mm. to 4 mm. Color, yellow, inclined to brown upon disk, often quite dark; shape, elongated oval, nearly flat; smooth and shining, with sparse punctures upon the disk; after death the border above often becomes wrinkled radially for narrow space. The antennæ are seven-jointed, the fourth and seventh subequal in length, and the third but little shorter; one, two, five, and six short and subequal. The legs are long and comparatively slender, with the tarsi shorter by one fourth than the tibiæ; the hair upon the trochanter is very long, and the tarsal claw is large; the tarsal digitules are long and much widened at their extremities; and also stout at the base. The anal ring is very small and is furnished with six long stout bristles.

Young Larvæ.—Long oval; antennæ with six joints only, of which the third is the longest.

The male of this species has never been found, although it has been studied from the time of Linnaeus down. The species is viviparous. This is the commonest and most widely spread of any of the bark-lice we have considered. In the United States we have received it from all quarters.

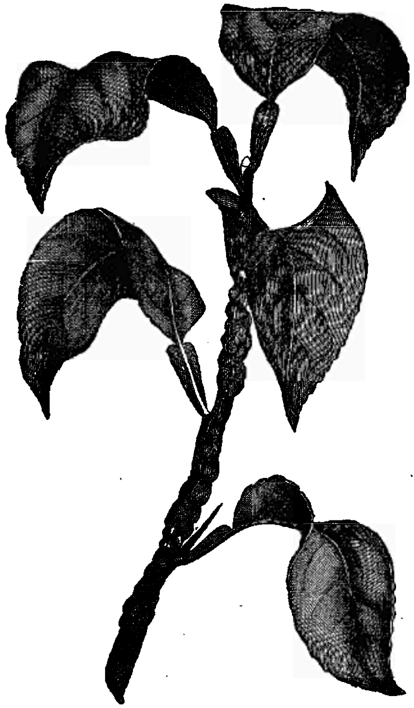


Figure 60.

[A dark brown, oval scale, infesting citrus trees and ornamental plants. Figure 60, a branch of orange thickly infested with the scales.]

We have no data concerning the number of generations each year; in fact, they are not well marked.

Three species of parasites have been reared from this bark-louse. The first, *Cocophagus cognatus*, from *Lecanium hesperidum*, on oranges in Florida; the second, *Comys bicolor*, from scales on ivy at Washington; and the third, *Encyrtus flavus*, from orange scales in California.

Remedy

This scale is not met with as much as a few years ago, internal parasites keeping it in check. It infests citrus trees mostly. The following remedy is very effective, and will not injure foliage or fruit: One pound of caustic soda is dissolved in one and one half gallons of water; then two pounds of resin and one pound of tallow are dissolved in one quart of the lye. After the resin is all well dissolved by moderate heat, the lye is added slowly while cooking under continued stirring; the mixture, if good, will become dark brown and thick. Should it become whitish and flocky (this is caused by too much and too strong lye), water should be added, and it will become right again. This will make twenty-two pints of soap, for water should be added to make that amount, after the lye is in it, at a cost of 11 cents, excluding labor and fuel in preparing it, which amounts to but little, and will be sufficient for forty-four gallons of wash sprayed well.

BLACK SCALE.

Lecanium oleæ, Bernard.

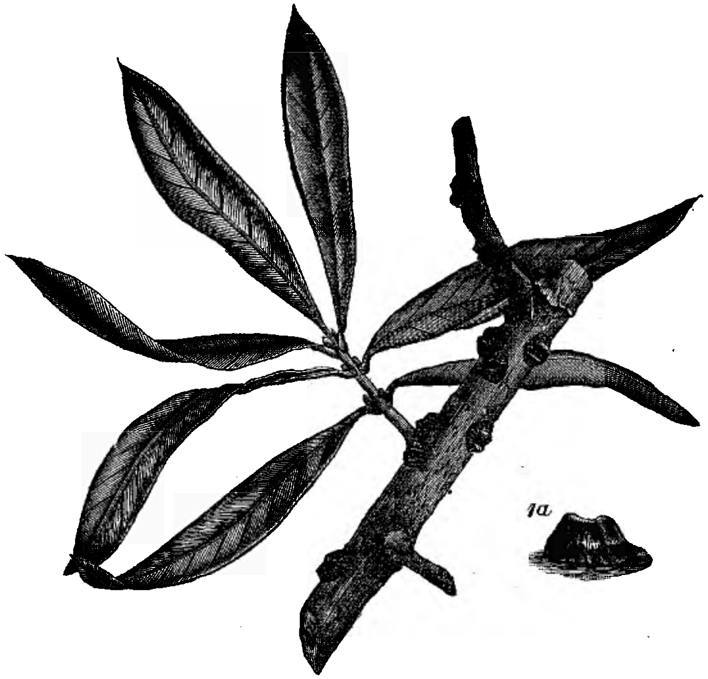


Figure 61.

[A blackish brown scale, very common throughout the State. Infests nearly every kind of plant. It is more troublesome on the olive than on any other tree; next to the olive citrus trees suffer the most from their attacks. Figure 61 represents an olive branch infested by the scales. (1*a*) Female, enlarged.]

Adult Female.—Dark brown, nearly black in color; nearly hemispherical in form, often, however, quite a little longer than broad; average length, from 4 mm. to 5 mm.; average height, 3 mm. Dorsum with a medium longitudinal carina and two tranverse carinæ, the latter dividing the body into three subequal portions; frequently the longitudinal ridge is more prominent between the transverse ridges than elsewhere, thus forming with them a raised surface of the form of a capital H. The body is slightly margined; outer part of the disk with many (eighteen to thirty) small ridges, which extend from the margin half-way up to center of dorsum. Viewed with the microscope, the skin is seen to be filled with oval or round cells, each with a clear nucleus, the average size of the cells being from .05 mm. to .06 mm. in length, while the nuclei average .02 mm. in diameter. The antennæ are long and eight-jointed, the two basil joints short; joint three longest; joints four and five equal and shorter; joints six and seven equal and still shorter; joint eight with a notched margin and almost as long as joint three. Legs rather long than stout, the tibiæ being about one fifth longer than the tarsi. The anal ring seems to bear six long hairs.

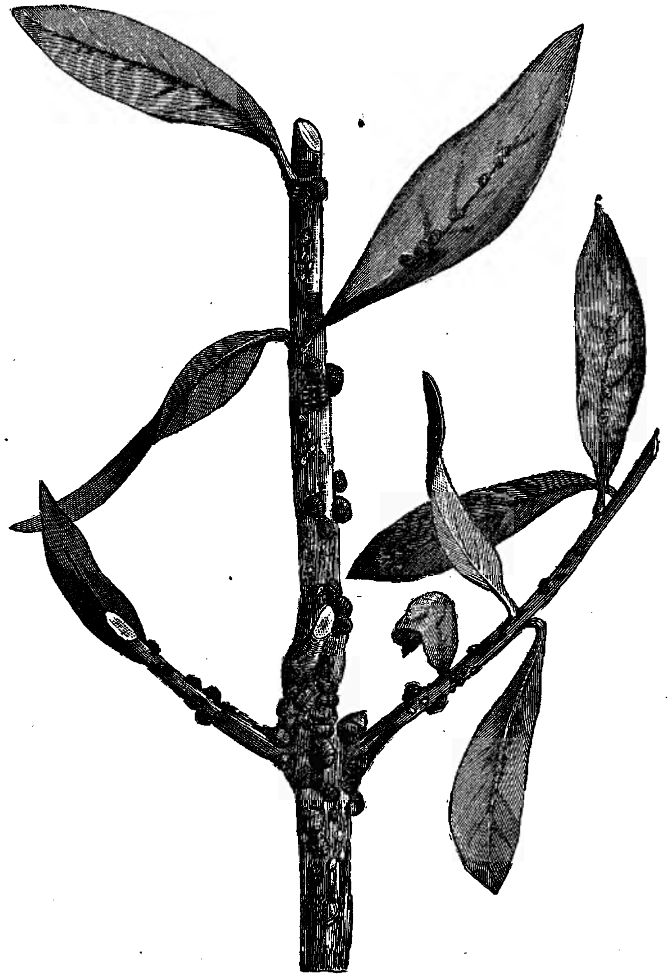


Figure 62.

[Figure 62 represents an olive branch infested with black scale, *Lecanium oleæ*, as they appear on larger branches. This scale is mostly confined to the branches, large and small, but also settles on the leaves and on the fruit. The dead bodies (shells) remain on the tree after the young escape from under them.]

The Eggs.—Long oval in shape, 0.4 mm. in length, yellowish in color.

Newly hatched Larvæ.—There is nothing very characteristic about the young larvæ; they are flat, and their antennæ are only six-jointed.

The black scale is stated by Signoret to be properly in France an olive scale, sometimes, however, becoming so common as to occur on all neighboring plants also. It infests the greatest variety of plants, and becomes a very serious enemy to orange and other citrus trees. It preferably attacks the smaller twigs, and the young usually settle upon the leaves. The development of this species is very slow. There is only one brood in a year.

Remedy.

This scale is very troublesome, especially on olive trees. Mr. Ellwood Cooper states that "they are harder to kill on the olive than on any other tree." The kerosene emulsion is the best remedy in use against it on the olive. On citrus trees various remedies are used successfully.

Kerosene Emulsion for Olive Trees.

Kerosene, 150 degrees test	5 gallons.
Common soap (laundry)	1½ pounds.
Water	2½ gallons.

Directions.—Boil the soap and water until the soap is thoroughly dissolved; place in a tub or barrel, and add the kerosene, and churn with a dasher, or pump through the nozzle until emulsified; then use, first diluting one gallon with six and one half gallons of water; and to this mixture add two and one half pounds of good home-made soap, dissolved in hot water. All the mixing should be done with hot water, and applied at a temperature of 140 degrees Fahrenheit. During spraying great care must be taken not to allow the oil to raise on the surface of the water. The best way to prevent this is by one man doing the stirring while the other men do the pumping and spraying.

Remedy for Citrus Trees.

The kerosene emulsion can also be applied on citrus trees with good effect; but being expensive, and as cheaper remedies are as effective on citrus trees, the following remedy is used with very satisfactory results:

Ingredients for One Barrel of Fifty Gallons.

Potash	14 pounds.
Caustic soda, 98 per cent	8 pounds.
Lime, unslacked	5 pounds.
Fish oil, polar or seal	10 gallons.

Directions.—*First.*—Dissolve the soda and potash by placing them together in twelve gallons of water.

Second.—Slack the lime in the barrel to be used, in two gallons of water, then add the fish oil to the lime, and stir well until the lime and the oil have turned to a thick batter; then add the soda and potash, water boiling hot, and stir well with a dasher for five minutes or more, then leave standing four or six hours; at the end of four or six hours fill up with cold water; do not pour in all the water at once, but about two buckets at a time; stir well as the first two buckets go in, to prevent lumps. Use the following day. Apply cold, one pound to the gallon of water. In dissolving it do not boil, but weigh the amount to be used, place in a barrel, and on top of it pour hot water, about one bucket to every hundred pounds. After pouring in the hot water stir lively with a dasher until it is entirely dissolved, then reduce, with cold water, sufficiently thin enough to pass through the strainer; then place in the tank and fill up with water, stir well, and it is ready for use. Apply cold.

BROWN APRICOT SCALE.

Lecanium. (Sp. unnamed.)

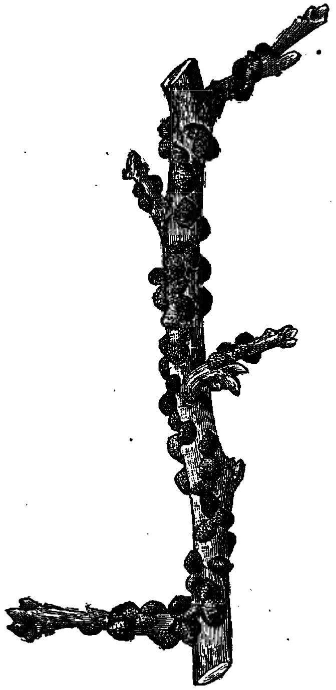


Figure 63.

[A brown scale insect infesting the apricot, plum, prune, cherry, etc.]

This scale (Figure 63), until recently, had not made its presence felt, as it had confined itself to only one fruit district. Within the past two years it has appeared in many places where it was never before known to have existed. This scale insect resembles the brown or soft orange scale (*Lecanium hesperidum*), but differs greatly in its characteristics. It infests the apricot, prune, plum, and has been found on the cherry and the pear, but does not infest the latter fruits as much as it does the apricot and prune. On the apricot and prune trees it has been very troublesome, owing to the fact that during the summer months the trees present a dirty black appearance, caused by a fungus formed by the excretions from this scale. This fungus also blackens the fruit. During the spring and summer months the trees (new growth) are very tender, and for that reason are difficult to treat or spray, unless with such remedies as do not injure the tender foliage, and these are usually too weak to kill the scales. The eggs are white, and in shape resemble those of the black scale (*Lecanium oleæ*) but are much smaller. They hatch during the months of June and July, but have also been known to continue hatching until September. There is but one brood a year.

Remedy.

The following remedy has proved very satisfactory, applied during winter, when the trees are dormant:

Unslacked lime	50 pounds.
French sulphur	20 pounds.
Salt	15 pounds.

Prepared as follows: Place ten pounds of lime and twenty pounds of sulphur in a heater with twenty gallons of soft water. Boil for half an hour or more, until both lime and sulphur are dissolved. The sulphur must be thoroughly dissolved and mixed with the lime; the mixture will then be of an amber color. Next place in a cask or box forty pounds of good lime and pour upon it enough soft hot water to thoroughly slacken the lime and keep it in a liquid form. After the lime is thoroughly slacked, add fifteen pounds of common stock salt while the material is hot. When the salt is well dissolved mix the two lots together, with sufficient water to make sixty gallons of spraying material, which will then be a thin whitewash. The material should be strained after being thoroughly mixed—a good piece of burlap answering well for the purpose. Apply the mixture with a spray pump, using a rubber plate in the nozzle instead of the brass plate.

PLUM SCALE.

Lecanium persicæ, Fabr.

This scale insect resembles the black scale (*Lecanium oleæ*) in appearance, but is much larger, being the largest of the scales described. The eggs are white, changing to yellowish white before hatching. There is but one brood a year; they hatch through the months of June, July, and August. Besides infesting the prune and plum, they also infest the English walnut, but are not considered a troublesome pest.

Remedy.

This insect, being a Lecanium, can be destroyed with the same remedy as used against the black (*Lecanium oleæ*) scale. (See remedies.) On plums, prunes, and walnuts they can be very easily destroyed during the dormant period of those trees.

LIVE OAK SCALE.

Subfamily Coccinæ. Genus Kermes.

Body perfectly globular, or with a slight incision for insertion on the twig or branch. On an external examination no trace of antennæ, legs, or even mouth parts is to be observed, and the insect presents precisely the appearance of a gall.

In the larvæ, however, the true characters of the Coccinæ are seen—multi-articulate lower lip, and the absence of the anal plates. The larval characters are the ones which have been principally used in the description of species, as they are easy to find. They, the larvæ, are long, oval, the abdomen plainly segmented, and deeply cleft at the extremity, except in *K. vermilio* and *K. ballotæ*. Upon each segment there are several spines at the lateral edge, and several hairs upon each disk. The lateral lobes have each a bundle of spines and a very long hair. Antennæ six-jointed; joint

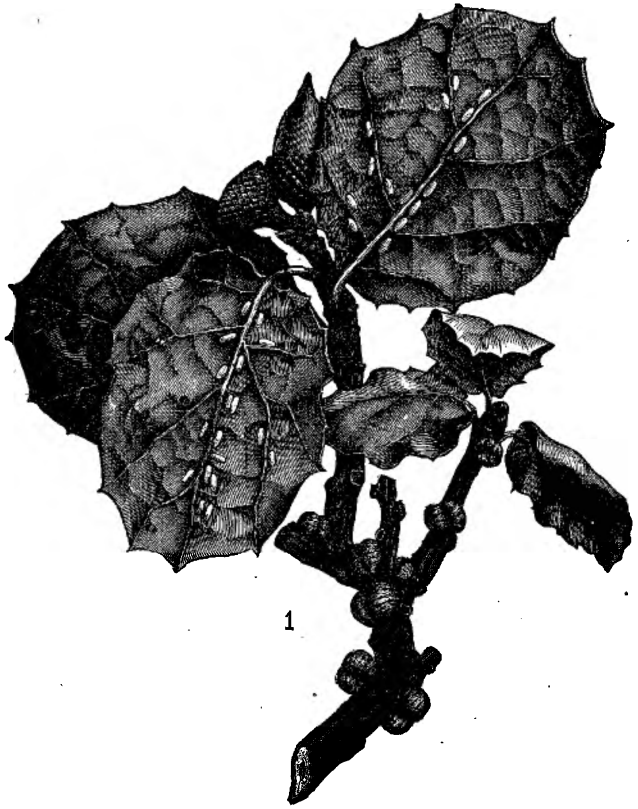


Figure 64.

[This scale is chiefly found on oak trees, being very common on the live oak, and on various other species.]

three longest. With all the lege the tibiæ are shorter than the tarsi. With the adult the antennæ and legs appear natural; but in very old individuals, which have secreted the horny covering, the antennæ are still present but deformed; so also with the legs, but the latter are sometimes entirely wanting. (Signoret.)

The males resemble those of other Coccinæ, and are inclosed in a little, white, felt-like sac. Head globular, with four eyes and six ocelli in *K. bauhinii* (the only species observed by Signoret). The antennæ are very long; joint three longest, joint ten shortest, and carrying several hairs with buttoned tips. Wings long; abdomen long, with a short genital armature, and two long bristles each side; legs long, the tibiæ longer than the tarsi, the latter with a long claw, and the four ordinary digitules.

Remedy.

This scale infests several species of oaks; it does not confine its attacks to the live oak exclusively. Young ornamental oaks have suffered greatly from their attacks, not that they affected the tree, for no such signs are visible, but rendered the foliage very unclean, and caused alarm, as it was thought they would spread onto fruit trees. This, however, has not been the case. The same remedies used for the oak scale (*Chionaspis quercus*) apply to this one (see remedy). Oaks can stand strong caustic solutions only, however, during the dormant period. When young oaks are putting forth new growth, it is easily destroyed.

NORFOLK ISLAND PINE SCALE.

Rhizococcus araucariæ, Maskell.

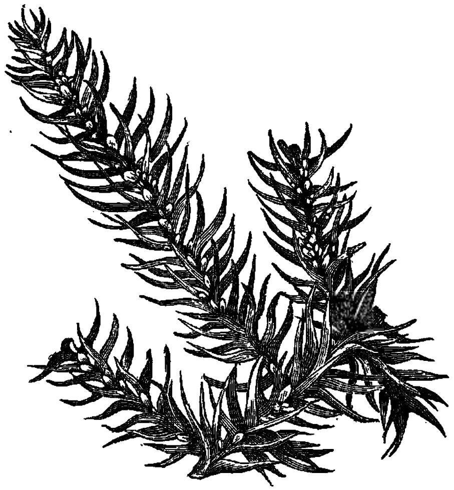


Figure 65.

[A small, soft, white, scaly insect, infesting the Norfolk Island pine (*Araucariæ excelsa*). Figure 65 shows the scales as they infest the pine, settling mostly at the base of the leaf.]

Found very common on the Norfolk Island pine (*Araucaria excelsa*) growing in open air.

When a tree is badly infested with this pest it becomes blackened with a black fungus, which is *Fumago salicina*, which accompanies Coccids on orange and other trees. This is often the first indication of the presence of the insect. But when an infested tree is carefully examined, numerous white cocoon-like sacs containing the full grown insects may be seen closely applied to the sides or bases of the leaves. Frequently these sacs are so massed at the ends of the twigs that the bases of the leaves are completely covered. The immature insects are not so easily seen with the unaided eye, as they differ a little in color from the tree. They are greenish yellow, and are usually to be found in the angles formed by the bases of the leaves. The larvæ of both sexes and the adult females are similar in form. The posterior end of the body is furnished with two prominent lobes, each terminated by a long hair. Between these lobes there is a conical mass of white waxy matter projecting backwards. The margin of the body is fringed with a row of tubular *spinnerets*. Excepting these filaments and the caudal tuft, but little excretory matter is to be seen; so that although the insect resembles a mealy bug in the form of its body, it differs greatly in appearance. The female when full grown measures 2.3 mm. (.09 inch) in length. When the female is ready to lay her eggs, she excretes a cocoon-like covering to the body, composed of white waxen threads. This sac is dense like felt, but easily torn; it is open on the middle line of the ventral surface or very much more delicate on that part. It adheres to the tree quite firmly, remaining where excreted after the death of the insect. As the eggs are laid, the body of the female shrinks away, making room for them, and finally it becomes a very small pellet in the anterior end of the sac, the remainder of the space being filled with eggs. These are light yellow in color. When the male larva is ready to undergo his metamorphoses, he secretes a covering to his body resembling the sac excreted by the female, except that it is very much smaller, measuring only 1.33 mm. (.05 inch) in length. From this sac the adult insect emerges as a delicate, fly-like creature, with two large wings, and a pair of long waxen filaments projecting from posterior part of the abdomen; these filaments are very conspicuous, being white, and longer than the body of the insect. Color of the body, white, with many irregular brown markings.

I have not sufficient data to ascertain the number of generations of this insect each year. August twenty-seventh, I found specimens in all stages of development.

Remedy.

This scale is generally found infesting the Norfolk Island pine, between the leaflets of the pine, very much resembling the mealy bugs. The insect is very soft. Pines infested with this scale soon begin to turn yellow, and the leaflets drop. Strong caustic solutions cannot be applied to pines. The best remedy for this scale is strong tobacco water, applied warm; a bar of laundry soap should be added to aid it in sticking on the leaves. It will not do, however, to allow this to remain on the trees too long. In two or three hours after it has been applied, it should be washed off with cold water (apply the hose) to prevent any injurious effect to the tree.

Genus Dactylopius.

To the genus Dactylopius belong the insects commonly known as mealy bugs. The antennæ of the female are six-jointed in the larva, and eight-jointed in the adult; the male larva has seven-jointed antennæ. The tarsi are furnished with four digitules, and the anal ring with six hairs.

COMMON MEALY BUG.

Dactylopius adonidum, Linn.

Under the specific name of *adonidum* have been classed the various species of "mealy bugs," common in greenhouses throughout the civilized world. It would be difficult, if not impossible, to determine beyond a doubt the particular form to which Linnaeus gave this name, more than one hundred years ago. Consequently, the best course to follow is to accept the conclusions of Signoret, who has given this genus the most careful study that it has yet received. The following is the description of the species to which he applied the name given by Linnaeus:

The *female* is 2½ mm. to 3 mm. (0.1 to .12 inch) in length, and 1.5 mm. (.06 inch) in width; white, a little yellowish, with a brown band upon the middle of the back; the legs and the antennæ a little brownish, powdered with a great quantity of floury matter secreted through pores scattered over the body; in addition to this, each lateral lobe or segment presents a secretion which forms a border of woolly appendages around the body, varying in length; those near the posterior end of the body are longer, and four at the abdominal extremity are very long; the two internal ones are longest, equaling and sometimes surpassing the length of the body. The antennæ are composed of eight joints, of which the eighth is the longest, and the third, and the second, fourth, and fifth the shortest, and of equal length; sixth and seventh a little longer than the fourth and fifth. The antennæ are slightly pubescent, the tibia twice as long as the tarsus; claw strong and long, with the digitules slender and furnished with a very little knob. The abdomen presents upon the suture of the first and of the second segment, and upon the median line, a cicatrice more or less visible and more or less rounded; upon the suture of the fourth and fifth, on each side, nearer the margin than the median line, an oblong cicatrice; upon each segment a great quantity of pores, in the form of rounded points, and some scattered hairs. Each lateral lobe presents a space with rounded pores, then two conical spines more or less strong; this is the apparatus secreting the cottony mass of which is formed each lateral appendage; the lobes of the extremity of the body have many more pores, and the conical spines are much larger; a little lower down arise two hairs, one of which is large; around these is condensed the secretion furnished by the pores. The anal ring is very large, dotted, and has six quite long hairs.

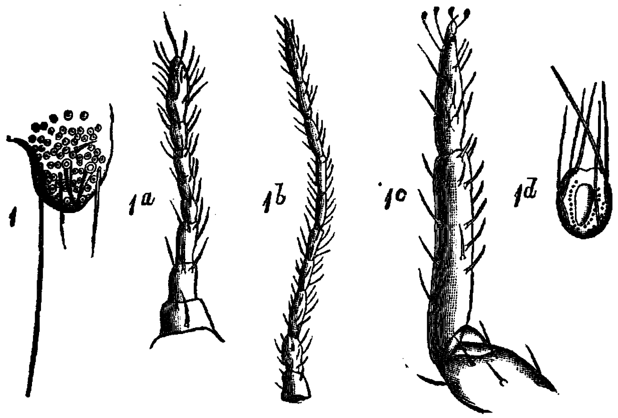


Figure 66.

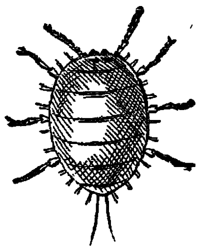


Figure 67.

[A soft scale-like insect. Infests mostly greenhouse plants. The insects crawl about slowly, and are more or less covered with a whitish, mealy powder. Figure 67 represents the female, enlarged. Figure 66: (1) Lateral lobe of the abdominal extremity of the female. (1*a*) Antenna of the female. (1*b*) Antenna of the male. (1*c*) Leg of the female. (1*d*) Anal ring with six hairs.]

The *larva*, varying in size according to its age, is more flat, of the same elongated form, and of the same color, but differs in the antennæ, which have only six joints. Other individuals, of a uniform shape and more elongated, have seven-jointed antennæ; these are the males which are to undergo another molt, which very often is indicated by the rolling up of the oval setæ, and sometimes by the future antennæ and legs which are already indicated within the members of the larva. In this type, the tibia is hardly one third longer than the tarsus.

The *male* we bred from larvæ with seven-jointed antennæ; in order to undergo their metamorphoses, they form little cottony sacs. The adult is long, of a brown, neither yellow nor red, with the segmentations paler. As it becomes older, it grows darker, especially upon the head and the corneous pieces of the thorax. The wings are long, largely rounded, of a gray more or less deep, reddish toward the side. The poisers are long, yellow, with a single bristle, hooked at the extremity. The prothorax is long, rounded upon the sides, straight in front, rounded behind, with a black arc upon the mesothorax. The abdomen is long, terminated by a rounded armature, thick, presenting some hairs. The lateral lobes of the last segment present two long threads of white cottony matter, secreted by numerous rounded pores; in the middle of each lobe are two long hairs and one smaller, around which the matter is condensed; the lobes above present much smaller ones, with two or three rounded pores. The head is thick, in the form of a ball, a little truncated in front, more convex below than above, and pubescent, except upon the pigmentary circle of the eye and ocelli. We have not determined exactly the number of the ocelli, which we think is four. The legs are long, with a large tarsus, flat, pubescent, presenting a very long and narrow claw. We have not been able to see the digitules of the claws. As to those of the tarsi, they are not larger than ordinary hairs, with a very little knob at the extremity.

Remedy.

Mealy bugs are hard to exterminate, on account of the tender character of the plants they infest. Whale-oil soap and tobacco water is the best remedy. Whale-oil soap solutions, however, can only be applied to hardy plants. Cold tobacco water can be applied to soft-wooded plants at any time of year. After the tobacco water has had its effect, one or two hours after application, it should be washed off the plants. One or two applications will rid the plants of the mealy bugs.

The following sulphur and lime solution is also effective, viz.:

Sulphur	2 pounds.
Lime	1 pound.
Water	2 gallons.

Boil together for one hour, then add six gallons of water, or more water in case of very soft-wooded plants. In case of tender plants allow the mixture to cool before applying it. After it has been on the plants thirty minutes, wash off with cold water.

DESTRUCTIVE MEALY BUG.

Dactylopius destructor, Comstock.

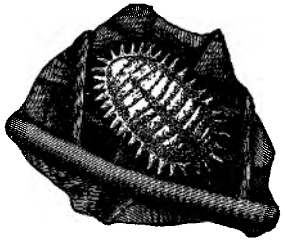


Figure 68.

[A small, yellowish bug, similar in appearance to *Dactylopius adonidum.* Infests citrus trees, but mostly greenhouse plants.]

Adult Female.—Length, 3.5 mm. to 4 mm.; width, 2 mm.; color, dull brownish yellow, somewhat darker than with *D. longifilis;* legs and antennæ concolorous with body. The lateral appendages (seventeen on each side) are short and inconspicuous, and are subequal in length. Upon the surface of the body the powdery secretion is very slight. In spite of the small size of the filaments, the spinnerets and the supporting hairs are as numerous and as prominent, or nearly so, as in *D. longifilis*, those upon the anal lobes being especially long. Antennæ eight-jointed; joint eight is the longest, and is twice as long as the next in length, joint three; after three, joints two and seven subequal, then five and six, joint four being the shortest. The tarsi are little more than half the length of the tibiæ, and the digitules are as in the preceding species; claws strong.

Eggs.—Length, 0.25 mm.; shape, rather long, ellipsoidal; color, light straw yellow.

Young Larva.—Rather brighter color than the egg. Antennæ, six-jointed with the female, with the same relative proportions as in the preceding species; tarsi considerably longer than the tibiæ. The lower lip is large, conical, and reaches almost to the posterior coxæ.

Male.—Length, 0.87 mm.; expanse of wings, 2.5 mm.; color, light olive brown—lighter than in following species; legs concolorous with body; antennæ, reddish; eyes, dark red; bands darker brown than the general color; anterior edge of mesoscutum and posterior edge of scutellum darker brown. Body, as will be seen from measurements, rather small and delicate compared with the size of the wings; head small, with almost no hair; antennæ ten-jointed; joints three and ten longest and equal; joints two, six, seven, eight, and nine, nearly equal, and considerably shorter than three and ten; joints three and four subequal and a trifle shorter than the following joints. The lateral ocelli are each just laterad of the center of the eye, and not at its posterior border, as in the following species. (This, however, is a character which will not hold with specimens long mounted.) Prothorax short; legs sparsely covered with hairs; tarsal digitules extremely delicate, and the button is very difficult to distinguish. We have been unable to discover a trace of the pair belonging to the claw. The anal filaments and the supporting hairs are similar to those of the following species.

This species is readily distinguished from *D. longifilis*, by the shortness of the lateral and anal filaments in the female. Indeed, for convenience sake, we have been in the habit of distinguishing them as the mealy bug with short threads and the one with long. The life history of this species differs quite decidedly from that of *D. longifilis*, in that true eggs, which occupy quite a long time in hatching, are deposited. The female begins laying her eggs in a cottony mass at the extremity of her abdomen, some time before attaining full growth, and the egg-mass increases with her own increase, gradually forcing the posterior end of the body upwards until she frequently seems to be almost standing on her head. The young larvæ soon after hatching spread in all directions and settle preferably along the mid-rib on the under side of the leaves, or in the forks of the young twigs, where they form large colonies, closely packed together. As mentioned in the description, they are only slightly covered with the white powder, and many seem to be entirely bare, with the exception of the lateral threads.

Habitat.—This species is very abundant upon almost every variety of house plants.

Remedy.

The remedy recommended for *Dactylopius adonidum* applies to this insect. (See remedy.)

LONG-THREAD MEALY BUG.

Dactylopius longifilis, Comstock.

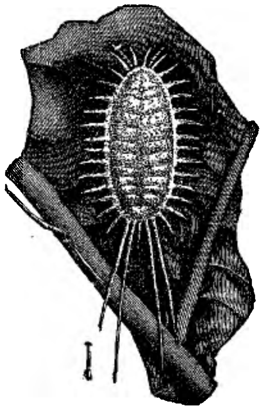


Figure 69.

[A small yellowish bug resembling *Dactylopius adonidum* and *Dactylopius destructor*; differs mostly by the long threads, as shown in the cut. It infests greenhouse plants, but has also been found on citrus trees.]

Adult Female.—Length, 4 mm. to 5 mm.; width, 2 mm.; color, very dull yellow; legs and antennæ a trifle darker; body rather sparsely covered with a whitish powder. The lateral appendages, numbering seventeen on each side, are long, the two posterior ones on each side very long, equaling if not surpassing in length the whole body. Antennæ eight-jointed; joint eight longest, then three, and then two, the difference being slight; joint six is next in size, and four, six, and seven are nearly if not quite equal. The tarsi are only one third as long as the tibiæ. The four tarsal digitules are present, and are knobbed; those of the claw are short and thick (although by no means as much so as in Lecanium), and the others very slender, and with a very delicate knob. Antennæ, tarsi, and distal ends of tibiæ, quite hairy. Along the lateral edge of the body are many tubercular *spinnerets*, in which large tubes can be seen running to the tips. Below these *spinnerets*, on each lobe, is a pair of sharp conical spines, and several longer or shorter hairs. The conical spines upon the last two segments are much larger than those upon any other. The anal lobes bear each a long hair. The anal ring is prominent, and bears the customary six tubular hairs.

Larva.—In color, similar to the adult. Antennæ six-jointed, the sixth joint longest—as long as the three preceding joints together; the others short and subequal. In the male larva the antennæ are seven-jointed; the tarsi somewhat longer than the tibiæ.

Male.—Wing expanse, 2.6 mm.; length of body, 1.3 mm.; color, light olive brown; antennæ and legs darker brown; band slightly darker than the general color; anterior border of *mesoscutum* and posterior edge of *postscutellum* dark brown; eyes, dark red; wings slightly dusky, with a faint bluish tinge. Body long and stout; head large, and strongly pilose behind the eyes. Antennæ ten-jointed; joint three longest, joint six next, joint ten a trifle longer than nine, and about the same length as seven and eight. Prothorax very long; legs very hairy; only two tarsal digitules are to be seen, those of the claw being rudimentary; they are short, very delicate, and with an extremely delicate button. Anal lobes each with long filaments, which, when the wax is removed, shows two long supporting hairs and one short one. The visible ocelli are seen just behind the lateral angle of the eye, on each side.

The female is very active when disturbed, and is not found with the cottony egg mass to be seen with many species of Dactylopius. The young is born enveloped in a thin pellicle or pseudovum, which splits a few moments after birth, and allows it to escape. The female surrounds herself with the cottony material, and the young cluster around and under the mother for some time. The growth is evidently quite rapid, and individuals of all stages are to be found at almost any time. The male larva, some time before pupation, forms for itself a little cottony sac or cocoon, in which it undergoes its transformation.

Remedy.

See remedy for *Dactylopius adonidum.*

GENUS ICERYA.

Antennæ eleven jointed; body covered by a cottony matter of several shades of color, and with a secretion of still longer filaments. Skin, with rounded *spinnerets*, and with long scattered hairs. Antennæ of nearly the same size throughout their whole length, and with a long pubescence. The digitules of the claw elongated and buttoned; of the tarsus as simple hairs. Genital apparatus terminating in a tube internally with a reticulated ring like a sphincter, and without hairs at its extremity. Antennæ of the larvæ six jointed, with a very long pubescence, and with four hairs upon the last joint much longer than the others. Lateral lobes of the extremity of the abdomen, with a series of three very long, frequently interlaced bristles.

COTTONY CUSHION SCALE.

Icerya purchasi, Maskell.

Adult Female.—Length 4 mm. to 8 mm.; color dark orange-red; legs and antennæ black, dorsal surface more or less covered with a white or yellowish white powder. The large egg sac is tinged with yellow and is longitudinally ribbed; it is a little longer than the whole body of the insect, and is filled with a loose white cottony mass containing the eggs. Over the whole surface of the body the skin is filled with circular *spinnerets*, each containing several openings; body clothed with short black hairs, dense at the margin of the body, forming tufts, and absent from the ventral side of the abdomen. Tarsi two thirds the length of the tibiæ; digitules of the claw very delicate and slender, and buttoned at tip.

Eggs.—Red in color, true oval in shape, 0.7 mm. long.

Newly hatched Larva.—Reddish, inclining to brown in color. Antennæ six-jointed; joint one short and thick, joints two, three, four, and five longer, slendered, subcylindrical, and subequal, joint six larger and club-shaped. (There is sometimes an additional joint between five and six.) All the joints except one with a few hairs; joint six with several, of which four are very long. Legs long and slender; tibia and tarsus with several long hairs; digitules of the tarsal claw proportionately much larger than in the adult, bent like hooks, and buttoned at tips; tarsal digitules represented by simple hairs. The six anal bristles are very long and conspicuous, each arising from a quite prominent tubercle. Six longitudinal rows of *spinnerets*

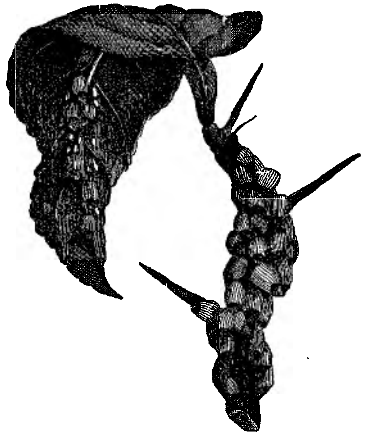


Figure 70.

[A cottony scale insect, infesting citrus trees, also forest trees, shrubs, and deciduous trees and plants, excepting the olive. Figure 70 gives a good representation of an infested branch. Figure 14, Plate IV, shows the insect in its natural size and color.]

are seen upon the dorsum, two rows sublateral and the other four more nearly in the middle. These rows soon become confused, and are no longer distinguishable after the larvæ have become somewhat grown. Alternating with the *spinnerets* are rows of hairs.

As the larva grows its appearance gradually changes. The outline, still oval, becomes more irregular, and its color is of a darker red, nearly brown. The six anal hairs become shorter, until they are indistinguishable from the other hairs of the body, which become more abundant, especially on the abdomen, where the lateral tufts of the adult begin to appear early.

The young larva soon begins to excrete tufts of a yellow waxy matter along the dorsal surface of the body and the lateral margins. The excretion on the dorsum consists of four pairs of large tufts, while along the margin is a simple row of poorly defined smaller tufts. Between the dorsal and lateral excreted masses the body is naked, thus leaving on each side a bright red line which contrasts strongly with the yellow excretion. Ventral surface of the body naked. From a row of large *spinnerets* around the lateral edge of the body project long, delicate semi-transparent filaments; and from between the posterior pair of dorsal tufts there projects a long, white, waxy filament (often 10 mm. or more in length), on the end of which is usually a drop of clear fluid. This filament is very brittle, so that a slight jar will cause nearly every one on a tree to break.

The insects seem first to settle upon the leaves, preferably along the midrib, and afterwards to migrate to the twigs and branches, or even the trunk.

Remedy.

Since the introduction of the Australian ladybug (*Vedalia cardinalis*) this scale insect is no longer a pest in California. The following remedy is, however, very effectual on citrus trees, evergreens, etc.:

Ingredients for One Barrel of Fifty Gallons.

Potash	14 pounds
Caustic soda, 98 per cent	8 pounds
Lime, unslacked	5 pounds
Fish oil, polar, or seal	10 gallons

First dissolve the soda and potash by placing them together in twelve gallons of water. Second, slack the lime in the barrel to be used, in two gallons of water, then add the fish oil to the lime and stir well, until the lime and the oil have turned to a thick batter; then add the soda and potash, water boiling hot, and stir well with a dasher for five minutes or more, then leave standing four or six hours; at the end of four or six hours fill up with cold water; do not pour in all the water at once, but about two buckets at a time. Stir well as the first two buckets go in, to prevent lumps. Use the following day. Apply cold, one pound to the gallon of water. In dissolving it do not boil; but weigh the amount to be used, place in a barrel, and on top of it pour hot water, about one bucket to every hundred pounds. After pouring in the hot water, stir lively with a dasher until it is entirely dissolved, then reduce, with cold water, sufficiently thin enough to pass through the strainer; then place in the tank and fill up with water, stir well, and it is ready for use.

Resin Solution.—The following solution is also effective and cheap: One pound of caustic soda is dissolved in one and one half gallons of water; then two pounds of resin and one pound of tallow are dissolved in one quart of the lye. After the resin is all well dissolved by moderate heat, the lye is added slowly while cooking under continued stirring; the mixture, if good, will become dark brown and thick. Should it become whitish and flocky (this is caused by too much and too strong lye), water should be added, and it will come right again. This will make twenty-two pints of soap, for water should be added to make that amount after the lye is in, and sufficient water is afterwards added to make in all forty-four gallons of wash.

COCHENILLE INSECT.

Coccus cacti.

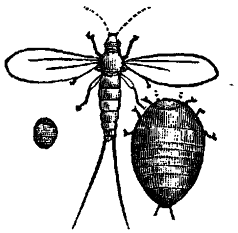


Figure 71.

Adult Female.—Dark reddish brown in color. From 6 mm. to 7 mm. long; 4 mm. wide, and from 2 mm. to 3 mm. high. Covered with a large quantity of white cottony powder; when this substance is removed it is seen to be strongly segmented, prismatic in form, in consequence of a dorsal carina, especially visible in dried specimens, and truncate behind, which gives it the form of a lance-head. The antennæ are short, conical, seven-jointed; the four basal joints short, thicker than long; joint five as long as thick; joint six a little longer, with a whorl of short hairs; joint seven as long as the two preceding together, with ten or eleven short hairs.

Larva.—In the newly hatched female larva the antennæ is six-jointed, slender, joint two very short, three longer, but it soon becomes deformed and thick, even in the larva state. There are other larvæ in which the antennæ only seem to show five joints, the second having blended with the third; there is also another type of larvæ which show only five joints. These differences indicate different states, either of the newly hatched larvæ or of the female or male larvæ. For these last we take those in which the legs are very slender and the antennæ of which, seen upon the cast skin, show a very short basal joint, a second five times as long, the third and fourth short, and the fifth longest of all and a little slenderer.

The legs also vary according to the age and sex. In the old individuals they become short, thick, and often with very indistinct joints; when not deformed they are generally thick, with the tarsi longer than the tibiæ in the larva, and almost as long in the old female. In the male larvæ the legs are slenderer, with the tarsal claws very long and accompanied by the four-buttoned digitules. The skin is smooth, with groups of *spinnerets* here and there, and a few scattered hairs. The newly hatched larva is oval, larger before than behind; the antennæ and legs are long; upon the lateral edge of each segment are two spines, a line of hairs each side of the median line, and a group of *spinnerets* near the lateral spines; between the double median line and the lateral spines is another simple line of short hairs.

Male.—The male is of a reddish yellow, darker upon the head and thorax, with brown legs and antennæ, and light gray wings. The head is thick, rounded, acuminate between the antennæ, with four smooth eyes and two ocelli. The antennæ are ten-jointed, with the fourth, fifth, and tenth longest, all joints furnished with a short pubescence, the hairs of which appear truncate; at the tip of the fifth and last joints is a much longer pubescence formed of buttoned hairs; joints one and two almost smooth, showing but one or two hairs (this is a character seen in no other genus). The legs are very long, with a sparse pubescence formed of little hairs, scattered over the disk and upon the sides; the tarsus is a third shorter than the tibiæ, and furnished with two very long digitules; the claw is very slender and very long, with its two digitules extending a little beyond it. The abdomen paler in color, is furnished on each side with a transverse line of small hairs; the lateral lobes of the extremity each with a protuberance covered with many *spinnerets*, and at each end furnished with three hairs, which support the waxy matter of the two caducous filaments, which are twice as long as the body of the insect. Between the two filaments is the copulating armature, composed of a very large tubercle, accompanied by a stylet shaped like a ventrally curved claw.

Upon the middle of the abdomen is sometimes seen a small brown spot, which forms a longitudinal band. Upon the prothorax anteriorly is a darker transverse band, as well as upon the meso and metathorax, and sometimes three longitudinal bands from the neck to the metathorax. Ventrally, the frame work of the sternum is browner. Although several individuals have been examined, we have never seen any balancer (Signoret). The wings extend for a third of their length beyond the abdomen, and are widely rounded at the extremity; the nervures are brownish yellow, with a reddish tint towards the body. This insect is added to the list, as it belongs to the family *Coccidæ* (scale bugs); it is only to be found on the cactus, and but rarely on this coast.

ALEYRODES SCALE.

Family Aleyrodidæ.

The insects of the genus Aleyrodes were for a long time classed with the Coccidæ. In their immature state they are scale-like in form, and often resemble certain species of Lecanium. But the mature insects differ so much from Coccids that the genus has been separated as a distinct family.

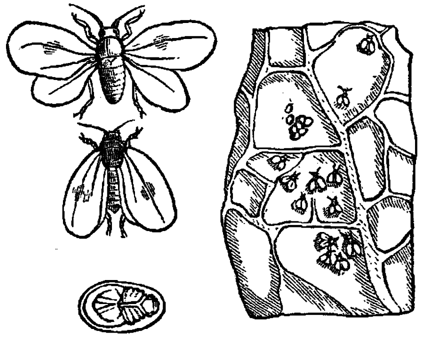


Figure 72.

They are very small insects; the species with which I am acquainted have an expanse of wings of about .11 of an inch. Both sexes are winged; and, as with other Hemiptera except the Coccids, there are two pairs of wings. In the adult state, all the species are of nearly the same color; the wings are white, sometimes spotted; the body is usually yellowish, sometimes pinkish, and more or less spotted with black. The most striking character presented by the adults, in addition to the fact that both sexes are winged, and each has two pairs of wings, is the presence of a whitish powder with which the wings and body are covered. It is this character which gives the name to the genus. With the adults the eyes are reniform, and generally divided into two portions, separated by a membrane; in some species they are more or less rounded or triangular. Above each eye there is a minute ocellus. The rostrum is stout, and composed of three segments. The antennæ are seven-jointed. The wings in repose are carried nearly horizontally. The first pair are the larger, and are transversed by two veins; the first vein, which passes through the middle of the wing, is much the larger; the hind wings have only a single vein.

Owing to their small size and similarity in color, it is difficult to distinguish the different species of Aleyrodes in the adult state. But the immature scale-like forms present considerable differences. The most common form that I have met is very flat, nearly circular in outline, and furnished with a beautiful white fringe; this fringe is composed of parallel fibers, which radiate from the margin of the body; and its white color contrasts strongly with the dark color of the insect. The segmentation of the body is often represented by prominent wrinkles, which give the insect a miniature resemblance to the fossils known to geologists as Trilobites. Sometimes the fringe of excretion is wanting; and in a common species on maple, the excretion from the margin of the body, instead of extending laterally and forming a fringe, is directed towards the leaf upon which the insect rests, and thus the body is lifted away from the leaf, and perched upon an exquisite palisade of white wax.

Remedy.

This scale is often met with on soft-wooded plants. It is very easily destroyed with strong tobacco water. Where it infests hardy plants alkaline and soap solutions should be used, as recommended for the black scale (*Lecanium olea*).

A decoction of tobacco is simple, inexpensive, and, if properly applied, an effectual remedy for every class of insect pests. Forty pounds of good strong leaf tobacco, thoroughly boiled in water, will make about eighty gallons of solution.

XXVI.

MISCELLANEOUS.

THE APHIDIDÆ.

The family of Aphididæ belongs to the order Hemiptera, which embraces those insects which may be properly designated in popular parlance as "bugs," and allied to it are the Pysllidæ, or the jumping plant-lice, and the Coccidæ, or bark-lice, both of which belong to the sub-order Homoptera. In this sub-order it is arranged in the division of Dimera, which contains, as the name implies, those plant aphis which have two joints in their feet, included with the jumping plant-lice, but from the different features which they present it would seem that they should properly be excluded.

Features of the Aphididæ.

The Aphididæ, or plant-lice proper, may be briefly described as small, oval or ovoid insects, ranging in size from about the one twentieth to one fourth of an inch in length, of green, or brown, or black colors, with a soft, tender, yielding body, joined often obscurely to the thorax, with a distinct head, bearing well marked and prominent eyes, and antennæ having from three to seven joints, and varying in length from little exceeding that of the head to twice the length of the body. A beak or proboscis arises from the back part of the head beneath, which, when not buried in the plant for sucking the sap, is usually pressed up against the breast. From one of the hinder segments of the abdomen, two short cylindrical or subcylindrical tubes are to be seen in many of the species, on the upper side of the back, which are commonly known as honey-tubes, from the purpose which they serve of discharging, often quite abundantly, a sweet liquid substance called "honey-dew." The legs are long, and show the usual principal divisions. The wings, when present, are four in number, transparent, with but few veins, and the front pair much the larger; they are often carried perpendicularly over the back, folded together. A more minute description would seem unnecessary in this connection, when we cite as good representatives of the family the apple tree aphis or bark-louse, shown in Figures 73 and 74.

Propagation of the Aphididæ.

The wide-spread distribution of the Aphides over the vegetable world, associated as they are with almost every plant that grows as if they were a natural product of it, and the excessive injuries which they have at times occasioned, will fully justify the claim that we have advanced of a special interest attached to them; yet nothing relating to these little creatures can equal the interest that pertains to their peculiar mode of propagation. No other insects are brought into the world in this same manner, nor does this same method occur elsewhere in the entire range of the animal kingdom. With them the old time honored adage of *ab ova omnia* would seem to be falsified.

Aphides, as a rule, hatch from eggs in the spring, that after fertilization had been laid the preceding autumn. They, the first brood, are all females, not an individual of the male sex occurring among them. They feed, cast their skins with their growth, perhaps four times, mature, and give birth to living young, all females. These maturing in some species in five days, in their turn produce living female young. And thus, without the presence of the male sex, this peculiar propagation is continued throughout the summer and through several successive generations. In one instance, as observed by Bonnett, through five generations in thirty-seven days. In another instance recorded, eleven consecutive generations have been observed in seven months. In the autumn males appear, and a different form of female. The sexes copulate, and fertilized eggs are deposited for winter hibernation, as before stated.

Nor is this mode of generation—*agamic*, as it is designated, being without a union of the sexes—necessarily limited to a portion of a single year. Kyber, in 1815, has had the rose aphis producing young for four years. From his carefully conducted experiments and from corresponding ones made by other naturalists, a law has been educed, which we dare not deny, "that under certain circumstances, a female aphis may, without coupling, continue *propagating to infinity*, provided that the necessary conditions for the development of the young—food and heat—are not wanting."

Various explanations have been offered in the attempt to account for the singular phenomena above narrated. It has been held to be the result of hermaphrodism, but this is not sustained by anatomical investigation. Some have seen in it a parthenogeneses quite beyond that which is occasionally observed in some of the higher insects, not infrequently in the Lepidoptera among the moths, when, as in numerous cases recorded, a female moth, reared in confinement, without the possibility of association with a male, has deposited fertilized eggs, which have produced their larvæ, and subsequently given the perfect insect, and in the queen honey-bee, the unfertilized eggs of which produce the drones. Others regard it as illustrating the "alternation of generations" of Steenstrup, in that several generations produced as living young are succeeded by another generation proceeding from eggs.

The natural history of the Aphididæ as a family cannot be given. They differ so greatly in the subfamilies in which they have been grouped, and even in the smaller groups, as to present very little in common. Accurate and satisfactory life histories must necessarily be confined to species. Further, as a family, they have been imperfectly studied. From its exceeding economic importance, the grape phylloxera has received careful and elaborate study, extending over a series of years, and bringing to its aid the best appliances of modern science, the highest scientific ability of Europe, united with very valuable investigation in this country. As the result, its entire life history, complicated and difficult as it is under the many forms assumed by it, and some of them hidden almost beyond the hope of detection, has finally been worked out.—(Lintner.)

The woolly aphis (*Schizoneura lanigera*, Hausm.) is another noted member of the *Pemphiginæ*, and of more than ordinary interest, from the two distinct forms under which it occurs, the one on the trunk and branches, the other on the roots. The latter was described by Dr. Fitch as *Pemphigus pyri*, under the belief that it was an entirely distinct species from the long known European form, *Aphis lanigera*, Hausm., and belonged to a different genus. The absolute identity of the two species has only been established after much discussion and no little controversy, and even yet some particulars relating to its history are unsolved and in dispute.

APPLE OR WOOLLY APHIS.

Schizoneura lanigera, Hausm.

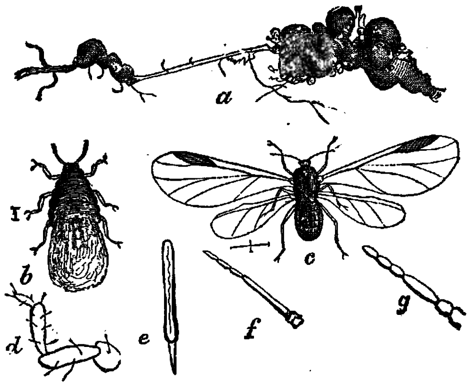


Figure 73.

[(*a*) The gall. (*b*) Larva. (*c*) Female. (*d*) Leg. (*e*) Beak. (*f*) Antennæ of female. (*g*) Larva.]

The woolly aphis is especially injurious to apple trees, the bark of which becomes, by their attacks, deeply pitted and scarred. The bark, apparently at the point of their attacks, ceases to grow, and swells into a large ridge about the cluster of aphis, leaving them in a sheltered pit. This insect is too well known, and, perhaps, the best known pest of the apple grower. It appears on the trunk of the apple tree, and also on its limbs, in a most conspicuous form.

According to Glover (Report Department of Agriculture, 1876) the eggs are deposited in crotches or cracks of the branches or bark, often at or near the surface of the ground, or on new shoots springing from the parent tree. They are mostly enveloped in a cotton-like substance, the young insects in a fine down, and are hatched out in the spring. As larva, pupa or perfect insect they are equally injurious, sucking the sap, and, when numerous, do much injury to the trees. These insects are 0.10 to 0.12 mm. in length, and are gregarious, feeding in societies (as shown in Figure 74, highly magnified), which, when seen from a short distance, resemble small bunches of cotton adhering to the trunk or branches of the tree. The insect, when denuded of its cottony covering, is egg-shaped, and of a dull reddish-brown color, with blackish head and feet; when undisturbed and feeding on the tree, it has a tuft of white down on the hind part of the body, which is very easily detached when roughly handled. These woolly plant-lice also produce warts or excrescences with their powerful beaks, and, when in great numbers on a young tree, cause the leaves to turn yellow, wither, and fall. The young ones are produced alive all summer, but in the fall the females lay eggs, which are able to withstand the cold of winter, and hatch out into young lice the following spring. Dr. Verrill states, that in the middle of October, among the wingless neuters, a large number of males and females appear, having well formed and rather large wings, in other respects closely resembling the rest, and having but little down on their bodies, very plump, and of a black color, the winged females of which are able to fly from tree to tree to deposit the eggs to be hatched out next spring. When the downy covering of these insects is removed by wind or rain, another supply is readily produced, and they are said to be able to withstand a very considerable degree of cold without perishing. These insects have no honey tubes, but frequently eject drops of a sticky substance from the extremity of their bodies.

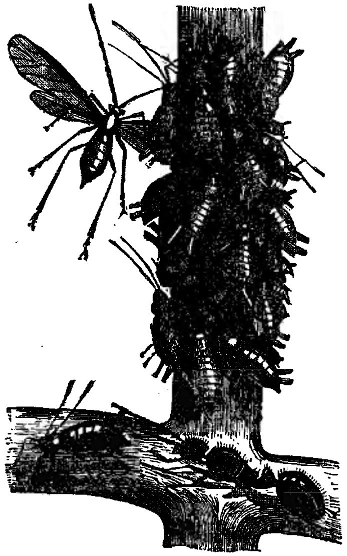


Figure 74.

Remedy.

The methods employed in the destruction of this aphis are varied, and as yet few have accomplished the desired results. There are various compounds recommended; however, none have been entirely satisfactory. During the past few years several new methods of treatment have been put in practice, which are now the best in use. They are as follows: When the aphis appears on the branches their presence is noticed by their white cottony covering; the parts infested are touched with a small brush dipped in kerosene; this is repeated from time to time, and in this way trees are kept comparatively free. The insect, however, infests the roots also, and for this reason it is most impossible to reach them with a remedy. In treating trees infested with woolly aphis at the roots, ashes and gas lime are quite effectual. About one and one half to two shovelfuls are placed around each tree. This must not be placed so as to come in contact with the bark.

LEAF CATERPILLAR.

Nematus. (Unnamed.)

This caterpillar, or slug, has given considerable trouble to pear growers, especially during the past few years. The young caterpillars make their appearance about the same time as the leaves do, and at once begin to feed upon them, commencing to feed near the stem, and continue until full grown. They (the caterpillar) then descend to the earth and forms a dark brown cocoon, in which it hibernates until the following spring.

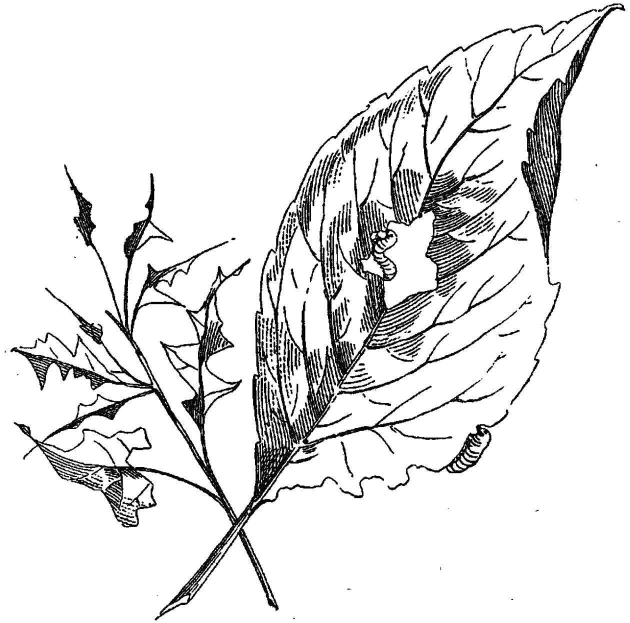


Figure 75.

Remedy.

As a remedy it is often suggested that "road dust" be dusted over the trees, etc. This is totally impracticable. The best remedy, so far, is Paris green, one pound to two hundred gallons of water, to which ten pounds of laundry or home-made soap (containing very little caustics) is added to keep the poison in suspension, applied in the spring of the year.

CHERRY OR PEAR SLUG.

Selandria cerasi, Peck.

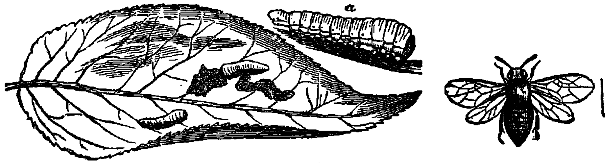


Figure 76.

[A slimy olive green worm half an inch long when full grown. (Figure *a*) Gnawing away the substance of the upper surface of the leaves. They make their appearance on trees in June and July, and again in August and September.]

The larva or slugs, as they are improperly called, are white at first, but soon become covered with an olive slime, which gives them something of the appearance of the naked snail, to which the name slug properly belongs. They are further easily distinguished from any other larvæ feeding upon the leaf by the fact that they are much thicker in front than behind, tapering gradually posteriorly. They have twenty very short legs, the first three pairs jointed, the remainder fleshy prominences, commonly known as prolegs. The head is of a dark chestnut color, small and unusually concealed under the forepart of the body. They live mostly on the upper side of the leaves of the trees, eating away all the parenchyma, leaving only the veins and epidermis of the under side. The slugs shed their skins five times, and after the last molt they lose their slimy covering and olive color, and are then yellow and free from mucus. From the first of July to the middle of August, having gained their growth, they leave the trees and burrow to the depth of one to four inches, forming an oval cavity in the earth, where the change to pupa occurs. From these cells they escape in the form of saw-flies from the middle of July to the last of August.

The winged insect is about one fifth of an inch in length, and is of a glossy black color, excepting the first two pairs of legs, which are a dirty yellow or clay color, with blackish thighs, and the hind legs, which are dull blackish with clay-colored knees. The wings are transparent, iridescent, with brownish veins and with a smoky cloud or band across the middle of the third pair. These saw-flies may be found on the leaves of the trees in the early morning, or in the cool of the evening, at which time they are sluggish and not easily disturbed. Their eggs are laid singly within little semicircular incisions through the skin of the leaf. From these a second brood of the slugs soon hatch, which get their growth and go into the ground again in September and October, remaining there until the following spring, when most of them are changed into flies and leave their winter quarters. Some of them, however, commonly remain unchanged in the ground until the following year, so as to continue the species if any complete destruction should overtake the remainder of the brood. These spring flies lay their eggs as already described, usually in June, the minute worms appearing in about a fortnight afterwards.

Remedy.

Various substances have been recommended for the destruction of these slugs, and of all the remedies used none have been so effectual as the application of Paris green, the same as used for the leaf caterpillar (*Nematus*), viz: one pound of Paris green to two hundred gallons of water. To this mixture ten pounds of soap is added, but the soap must not contain too much caustic. The solution must be stirred continually while being sprayed. It only requires to be strained when a fine spray nozzle is used. If a rubber disk be used in place of the brass plate, no straining is necessary, as all grains will blow through. Great care should be exercised in the time it is applied; if used when the trees are in bloom the pollen in the blossom will be washed away and the blossom will wither and fall off. Again, if applied when the fruit is very young and tender, it may burn and spot it. It should never be applied until the fruit is fairly set. A few pounds of good home-made soap (ten pounds as stated above) added to the solution will aid to keep the poison on the trees for a longer period of time, and will spread the Paris green better and prevent its evaporation by the action of the sun.

STRIPED SQUASH BEETLE.

Diabrotica tri-vittata, Mann.

This insect is quite troublesome, not only on the squash and cucumber vines, but also on foliage of trees, vines, and garden plants. In the larva or caterpillar state it bores into the lower part of the stem of tender vines. The beetle feeds on the leaves of plants, and also on leaves of trees.

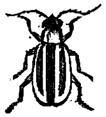


Figure 77.

The beetle generally makes its appearance very early in the spring, in fact it is wonderful that it seems to know just when the young leaves of vines are fairly above ground. When they infest very young plants, and after they have partially or wholly devoured the leaf, they follow the stem, eating it quite a way below the surface.

Remedy.

The best method for the destruction of the beetles is the application of a solution of Paris green—one pound to two hundred gallons of water. This application does not kill by contact, but by remaining on the leaves the beetles are poisoned while feeding upon them.

Paris green and sulphur—five ounces of the former to twenty pounds of the latter—have been used on the foliage of trees very successfully. The sulphur and Paris green are put into a sack, and the sack is tied to a long pole and shook over the trees. One application has driven away the beetles. This remedy should only be applied when the fruit is young.

TWELVE-SPOTTED DIABROTICA.

Diabrotica soror, Le Conte.

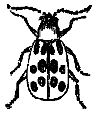


Figure 78.

This beetle is often confounded with the ladybirds, but is not a ladybird. Like the preceding one, this insect is very common throughout the State. In places, the cherry trees suffer greatly from their attacks. They feed on nearly all kinds of vegetation, but prefer that which is soft and tender. They are mostly destructive to squash and melon plants, cucumber, and other soft-wooded plants and vines. They are also destructive to corn and beans, by feeding on the tender leaves. The beetle is yellow, with twelve black spots, as represented in Figure 78.

Remedy.

Spray foliage with one pound of Paris green to two hundred gallons of water, when the insects appear. (See remedy for *D. tri-vittata.*) Very good success has also been attained by the application of *saltpeter*—one tablespoon dissolved in five gallons of water—applied around the infested plants. About one to two pints of the solution are sufficient for squash, cucumber, or melon vines. The application should be repeated from time to time, as the vines grow larger.

CODLIN MOTH.

Carpocapsa pomonella, Linn.

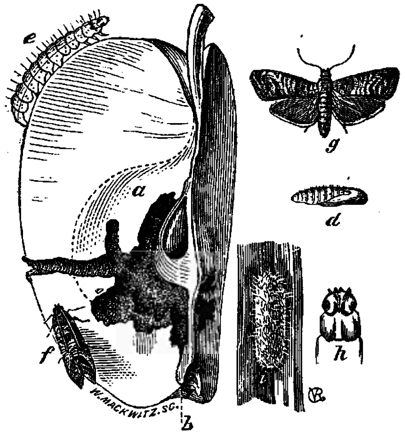


Figure 79.

[A moth laying its eggs at the blossom end of the fruit, infesting the apple, pear, quince, etc.; (*a*) shows the burrowing of the larva, (*b*) the point where it effected its entrance, (*e*) the larva full grown, (*h*) the anterior part of the body, magnified, (*d*) the chrysalis, (*i*) the cocoon, (*f*) the moth with its wings closed, and (*g*) the same with its wings expanded.]

The early brood of moths appears about the time of the opening of the apple blossoms, when the female deposits her eggs singly in the calyx of the fruit, just as it is forming.

In about a week the egg hatches and the tiny worm at once begins to eat through the apple to the core.

As the larva approaches maturity it eats a passage through the side of the fruit. The body of the larva is of a flesh color or pinkish tint, more highly colored on the back. The larva attains full size about three or four weeks from the time of hatching. The apples that fall to the ground, generally prematurely, sometimes contain the larva, but most of them do not drop until after the larva has made its escape. The larva as they leave the fruit, while the fruit is still on the trees, let themselves down to the ground by a fine silken thread, which they spin. They also crawl down the branches to the trunk of the tree; in either case they find their way to the trunks of the trees, or where there is rough bark, under which, and in cracks or crevices, they spin their cocoons.

Inside of the cocoon the change to the chrysalis takes place; this change in the early brood occurs in about three days; the insect remains in this condition about two weeks, when the moth emerges from its chrysalis. This is a night-flying moth; it conceals itself in the daytime and makes its appearance at night; it is therefore seldom seen.

The second brood occurs usually during the latter part of July, and in a few days the female begins to deposit her eggs for the later brood of larva. This brood generally attacks the later apples and pears. The larvæ of this second brood generally mature in the early winter months, and if they escape from the fruit before it is gathered, secrete themselves under the loose bark of the tree. If the fruit be gathered before they have made their escape, they are carried on the fruit into the storeroom or packing house, and as they leave the fruit hide between the cleats of the boxes or between the boards of the buildings, from which places they make their appearance as moths in the spring to begin the work of the following season. The larva of the codlin moth was formerly supposed to only attack the apple, the pear, and the quince, but besides injuring these, they have occasionally been found on the plum and on the peach.

Remedy.

Considerable has been done in the way of experimenting to destroy the codlin moth in the larva state, with arsenic solutions. Various mixtures have been tried, and general observations taken of the results. Paris green has given the best results, and is recommended for use. In many instances the results of twice spraying with Paris green in early spring, before the young apples had drooped upon their stems, resulted in a saving of from 75 to 95 per cent of the apples exposed to injury by the codlin moth.

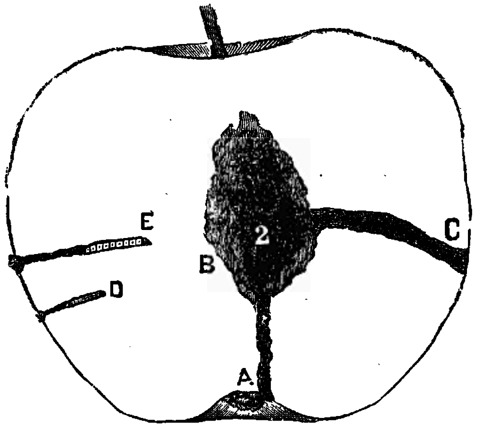


Figure 80.

[Figure 80: (*A*) The blossom end of the apple where the codlin moth larva is supposed to enter the fruit. (*B*) Represents an empty space where carpillary ovarium or shell containing the seeds was located before the entrance of the larva. (*C*) Represents the burrow, or outlet, through which the larva makes its escape. (*D*) Young larva in burrow. (*E*) Young larva approaching maturity, nearly reaching the core.]

Time of Application.—What must be taken into consideration is the time the solution of Paris green is applied; this, however, must be determined so that the poisoning will be the most effective; and whether, in fact, the principal effect is upon the first brood or the later ones. Professor Forbes, in discussing this important point in his bulletin on arsenical poisons, says: "A moment's reflection will show that if only the first brood of the larva was directly diminished in a certain ratio, the second brood should show a similarly diminished ratio, since these descend from the first; whereas, if both first and second broods are directly poisoned, then the ratio of damage to the second brood should be greater than that to the first; or, in other words, the percentage of benefit to the picked apples should be greater than to the fallen."

Great care should be taken that no spraying be done with arsenic mixtures until the blossoms have fallen, as otherwise it will kill many bees

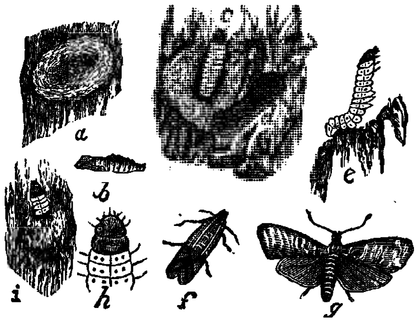


Figure 81.

[Figure 81: (*a*) Nest of larva on outside of trees, under the old bark; (*b*) pupa; (*c*) larva exposed from nest; (*d*) old nest; (*e*) larva about to build nest; (*f*) the moth at rest; (*g*) moth with wings spread; (*h*) head of larva.]

that visit the poisoned flowers, and will endanger the honey they gather. Spraying too early is useless.

The moth does not lay its eggs on the fruit until it is formed, therefore if applied before the eggs are laid the poison will disappear and lose its effect. The spraying should not be done until the blossoms have fallen from the trees, then no possible harm can come to bees or honey. The spraying cannot be delayed any longer than after the blossoms have fallen, for then the larva will have entered the fruit.

In case of no rains one application of Paris green is enough, but in case it should rain after an application, or within a few days, it will pay to give the trees a second application about two weeks after the first. To secure the best results the greatest care should be exercised in the use of the arsenic solutions.

Amount to Use.—The proportion used is one pound of Paris green to one hundred and sixty gallons of water. The Paris green is used without any additions, after having been dissolved with ammonia. If only one application is intended, and this made early, a little soap added to the solution will keep the poison on the foliage a much longer time.

Bands.—When the larvæ leave the fruit they crawl under rough bark, cracks, and crevices, under which they construct a papery-looking silken cocoon, which is disguised on the outside by having attached to the silky threads small fragments of the bark of the tree or other available debris. The time to trap the larva is at the time it lets itself down from the fruit on to the trunk. The most effective method for this purpose is the application of burlap bands around the trunk of trees, about six inches wide. The bands are placed just below the crotch of the tree, and are tied with a string or tacked to the tree by a single tack. The bands should be put on the trees not later than the first of June. As the larva descends from the fruit they hide under these bands and under them transform. These bands must be examined every *six* or *eight* days until the latter part of August, and as they are examined all the larvæ and chrysalids found under them destroyed.

One of the very best ways to do this is to make a solution of caustic soda, about one pound to the gallon of water, or stronger, and as the bands are examined they are dipped into the solution, and when dry are tied again. In this way all larvæ and chrysalids are killed the moment the band is immersed in the solution. If the trees have rough bark this should be scraped away, and the body of the tree treated with a coating of whitewash and soap, to prevent sunburn. The fallen fruit should be promptly destroyed to prevent the larvæ from escaping.

The moth is a night-flying moth, and therefore not attracted by light.

RED-HUMPED CATERPILLAR.

Notodonta concinna.

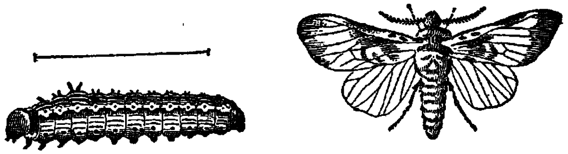


Figure 81½.

Different broods make their appearance at various times during August and September. The eggs from which they proceed are laid in the course of the month of July, in clusters, on the under side of a leaf, generally near the end of a branch. When first hatched, they eat only the substance of the under side of the leaf, leaving the skin of the upper side and all the veins untouched; but as they grow larger and stronger, they devour whole leaves from the point of the stock, and go from leaf to leaf down to the twigs and branches. The young caterpillars are lighter colored than the old ones, which are yellowish brown, paler on the sides, and longitudinally striped with slender black lines; the head is red; on the top of the fourth ring there is a bunch or hump, also of a red color; along the back are several short black princkles, and the hinder extremity tapers somewhat, and is always elevated at an angle with the rest of the body, when the insect is not crawling. The full grown caterpillars measure one inch and a quarter, or rather more, in length. They rest close together on the twigs when not eating, and sometimes entirely cover the small twigs and ends of the branches. The early broods come to their growth and leave the trees by the middle of August, and the others between this time and the latter part of September. All the caterpillars of the same brood descend at one time, and disappear in the night. They conceal themselves under leaves, or just beneath the surface of the soil, and make their cocoons. They remain a long time in their cocoons before changing to chrysalids, and are transformed into moths towards the end of June or the beginning of July.—Dr. Harris. This caterpillar is mostly to be found in prune and apple orchards, and is quite troublesome.

Remedy.

The best remedies for the destruction of this caterpillar are hand picking and Paris green. Upon jarring the branches all the large caterpillars fall to the ground and are thrown into a strong caustic soda solution, which kills them instantly.

In the bucket containing the caustic soda solution, a wire basket is arranged, which fits closely down to the bottom of the bucket. Before moving to another tree, this basket is raised up and its contents (caterpillars) thrown away. In this manner the liquid does not require to be renewed often. Spraying with Paris green will kill all the young caterpillars on the tree. The proportions used are one pound of Paris green to two hundred gallons of water. Great care must be exercised in the use of

Paris green at this season of the year. It should only be used when the fruit is still green.

EASTERN PLUM CURCULIO.

Canotrachelus nenuphar, Herbst.

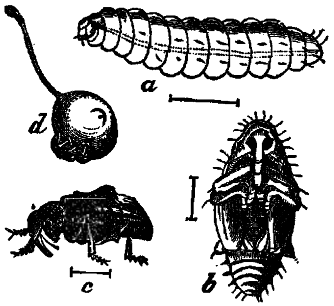


Figure 82.

This insect is without doubt the greatest enemy the plum grower has to contend with; for, when allowed to pursue its course unchecked, it often destroys the entire crop.[*] This insect has not yet made its appearance in this State, and the greatest of care should be exercised in keeping it out. It had been rumored that the eastern plum curculio had made its appearance in the State. Officers were at once detailed to make a thorough investigation, and the reports that the curculio had made its appearance in this State proved a hoax. A rose beetle (*Aramigus fulleri*) was mistaken for the curculio, and the report put afloat without any foundation of fact. However, as it is liable to be introduced into the State, and in order that in the future parties may study the forms of the beetles which resemble the curculio, so that reports may not be put afloat unless with great certainty, the following interesting account of it is appended from the report of the United States Entomologist:[†]

> The genus Conotrachelus is almost exclusively American. Of something over a hundred species which have been described, all are either from North America, Mexico, Central America, the West Indies, or South America, with the exception of *C. helferi*, said to come from East India, *C. hirsutus* and *C. hispidus*, which were described from the island of Lifu (South Pacific), and *C. tagax*, supposed to come from Caffraria. There is some doubt as to the correct generic reference of the first three species, and the locality of the last has been questioned. North America alone contains twenty-eight species. The plum curculio proper (*C. nenuphar*) is confined, so far as we can learn, to the United States, and was first described in 1797 by Herbst, and was redescribed by Fabricius and Dejean under different names. It was treated as an insect pest at least as early as 1746, and there is no doubt whatsoever that it is an indigenous species, feeding in this country upon wild stone fruits from time immemorial. It seems certain, moreover, that from the very first it has not been confined to any one section of the country, but has existed wherever wild plums grew. It seems tolerably certain, also, that the insect has increased enormously in parts where cultivated varieties have been introduced, and its comparative scarcity where only wild fruits grew years ago has frequently given rise to the idea that it was actually introduced with the cultivated varieties; whereas it furnishes simply another case of the preference of an indigenous insect for introduced and cultivated plants congeneric with, or allied to, its original food plant, with instances of which every student of economic entomology is so familiar. We need only mention the case of the Colorado potato beetle to furnish at once a striking example.
>
> At present the plum curculio is known from Canada to Florida, and west to the Rocky Mountains, as a stone-fruit destroyer. *It has not been found as yet, so far as we know, in California or elsewhere on the Pacific Coast*, and such collectors as Mr. James Behrens, Dr. J. J. Rivers, and our agents, Mr. D. W. Coquillett and Mr. Albert Koebele, *have never collected*

---

[*] Professor Saunders, insects injurious to fruit.

[†] Report Department Agriculture, 1888.

it west of the Rocky Mountains. Its appearance on the western slope, however, is probably only a question of time, when the intervening country becomes more thickly settled, *although it is interesting to note that twenty-two years ago Mr. Walsh commented upon the non-occurrence of the pest in California,* but did not predict its eventual introduction, because of the different character of the fauna and flora of the Pacific Coast. While there has always been some danger of the introduction of the pest into Northern California, Oregon, and Washington Territory, we think that the fruit growers of Southern California have little to fear, as we have observed that long dry spells usually destroy the pupæ in the ground. We therefore doubt whether it could successfully bridge over the long dry seasons which are there so prevalent.

FOOD PLANTS.

The plum curculio has brought about an almost entire abandonment of plum culture in many sections of the country within the last twenty years; but it is by no means confined to this fruit. It breeds in great numbers in cherries, peaches, apricots, nectarines, and other stone fruits, including the persimmon, and also infests many varieties of apples, crabs, and haws. It prefers, however, smooth-skinned fruits. It is also a common inhabitant of the fungus growth of plum and cherry known as "black knot" (*Plowrightia morbosa*), from which it was first reared by Peck in 1818.

It was at one time thought that this species bred in green butternuts and walnuts, making the same crescent-shaped mark in the outer skin of the nuts. Fitch noticed the insect upon butternuts, and recorded the fact that specimens so found were larger than the plum-fed individuals. Walsh afterwards bred the beetles from these nuts and sent specimens to Le Conte, who considered them as belonging to a phytophagic variety of the plum species, differing only in size. Walsh later pointed out a constant colorational difference, and Le Conte subsequently established a distinct species (*Conotrachelus juglandis*) for the nut-bred form.

HABITS AND NATURAL HISTORY.

The Egg and the Process of Oviposition.—The egg of the plum curculio is oval, of a pearl-white color, and large enough to be seen with the naked eye. Careful measurements indicate that the average length is about 1 mm. It is laid in green fruit soon after the blossoms fall. The number of eggs laid by a single female has been variously stated. Riley, in 1868, estimated from fifty to one hundred, which are laid at the average rate of five to ten per day. Prof. A. J. Cook, in writing to the New York "Weekly Tribune" of June 9, 1880, says: "I know by dissection that a single female may contain thirty eggs." Dissections made for us during the season of 1887, by Mr. Alwood, showed that early in May only one or two fully developed eggs could be found; many immature ova, however, could be seen. Late in May, however, from four to ten mature eggs were found in each female examined. No account of the actual number of eggs in an ovary at any one time was made, but from what we know of the rate of development Riley's estimate, based on dissection and observation, is unquestionably correct.

The process of depositing a single egg requires about five minutes. The description of the process published by Riley may be repeated: "Having taken a strong hold on the fruit the female makes a minute cut with the jaws, which are at the end of her snout, just through the skin of the fruit, and then runs the snout under the skin to the depth of one sixteenth of an inch, and moves it back and forth until the cavity is large enough to receive the egg it is to retain. She next changes her position, and drops an egg into the mouth of the cut; then, veering round again, she pushes it by means of her snout to the end of the passage, and afterwards cuts the crescent in front of the hole so as to undermine the egg and leave it in a sort of flap; her object apparently being to deaden this flap so as to prevent the growing fruit from crushing the egg, though Dr. Hull informs me that he has repeatedly removed the insect as soon as the egg was deposited and before the flap was made, and the egg hatched and the young penetrated the fruit in every instance." Many subsequent observations both under cover and in the field, made for us by Mr. Alwood, confirm the above. When he was able to time the operation, however, it required a longer period than that mentioned by Riley. The first cutting of the cylindrical hole occupied five minutes, the depositing of the egg thirty seconds, and the packing in of the egg and the cutting of the crescent slit from six to eight minutes longer. The time occupied varies, however, with the temperature and the vitality of the individual. In cutting the crescent the snout is swung to one side as far as the joint between the head and prothorax will permit, and is inserted into the fruit at an angle of about 45 degrees and directed backward under the body. The cut is continued around the egg-puncture as a center as far as the head will turn, and as far as the snout will conveniently reach. The resulting slit is therefore an arc of a circle. The object of the cutting of the crescent slit was first suggested by Mr. Franklin C. Hill, of Yellow Springs, Ohio, in the "Practical Entomologist," volume II, page 115 (September, 1867). After describing the operation, Mr. Hill says: "Can her object be to wilt the piece around the egg and prevent the growing fruit from crushing it?" Walsh and others immediately accepted this explanation, which is undoubtedly the correct one. Previous writers, including Walsh himself, followed Harris, who expresses himself on this point as follows: "The beetle first makes a small crescent-shaped incision, with its snout, in the skin of the plum, and then, turning round, inserts an egg in the wound." The eggs will hatch in from three to ten days, depending upon the weather, and, as the period of oviposition frequently extends over two months, a confusion of stages arises.

From Riley's observations it seems quite certain that many of the eggs which are deposited after the first of July fail to hatch, or the young larvæ die soon after hatching, owing, in all probability, to the riper and more juicy condition of the fruit at that season. A number of eggs may be deposited in a single plum, whether by the same female or not has not been determined. From one to a dozen of the crescent marks are often seen upon a single plum, while a single apple may carry a greater number.

The Larva.—The larva of the plum curculio is white and footless, and furnished with a horny head. It works its way, immediately after hatching, in stone fruit to the pit, and there grows to full size, eating the pulp around the stone. The larva attains its full growth in from three to five weeks, when it is about 10 mm. (0.4 inch) in length, rather stout, and of a glistening whitish color. The head is light brown, and there is a pale line along each side of the body. There is a row of small black bristles below the side lines, and on the second segment a less distinct row of bristles above; also a few pale hairs near the anal end of the body. The fruit thus infested falls prematurely, in a large majority of cases, with plums, apricots, and peaches; cherries, however, do not fall, but remain upon the tree. One or two varieties, particularly the English Morello, are said, however, to mature and drop. In cherries seldom more than one larva is found in a single fruit, but several are often found in a single plum, peach, or apple. Rarely are as many larvæ found in the fruit as there are punctures under the skin, and many eggs, therefore, fail to hatch.

After the fruit has fallen to the ground the larvæ may still remain within it for some time, but as soon as they are full grown they issue and enter the ground to pupate. Larvæ issuing from cherries drop to the ground for the same purpose. They seldom burrow to a greater depth than four or five inches, and at the end of the burrow they construct a small oval cell within which to pupate.

Pupa.—The pupa is white at first, becoming yellowish as it grows older. It remains in this condition from three to six weeks.

The Adult.—The beetle is familiar to most fruit growers, and is, besides, so well shown in Figure 82, at *c* and *b*, that a detailed description is unnecessary. While the females lay their eggs chiefly during daytime, the insect is essentially nocturnal, flying freely during the warmer nights and only seeking shelter when the nights are cold.

There has been much discussion upon the point as to how much the insect feeds in the adult state, as the question is important from a remedial standpoint. There is no longer any question about the matter, however, for Riley records the fact that the adult gnaws not only the fruit, but also the young twigs, and even the buds and leaves, for food, both in the spring and in the late summer. The holes in the young plums made by feeding are irregular, and need never be mistaken for the marks made by oviposition. Figure 82, shown at *d*, will indicate the size and shape of some of these food scars. The normal feeding spot is, however, not so large as the largest ones there indicated, and is usually circular. This taking of food by the adults is mainly noticeable in the spring, as the fruit and vegetation is at that time smaller and younger, and the beetles, after their winter fast, may be presumed to be hungrier. Some further observations upon the feeding habit in autumn have only recently been recorded by Prof. J. H. Comstock, who proved that this curculio is responsible for at least some of the numerous circular pits seen in apples in late summer and early fall, and has recorded his observations in the "American Naturalist" for November, 1888, pp. 1035 and 1036, under the caption "Serious Injury to Apples by the Plum Curculio." We quote from his article as follows:

"During the latter part of the past summer my attention was attracted to a serious injury done to the fruit in an apple orchard through which I passed daily. A large proportion of the apples in a corner of the orchard had been eaten into by something which made small pits from one eighth to one fourth inch in diameter, and of about the same depth. On one tree nearly every apple had been attacked, and in many cases there were ten or twelve holes in a single apple. The injury was so serious as to render fruit on this part of the orchard unmarketable.

"The holes in the apples were first discovered during the latter part of August. At that time many of them were partially grown over, while others were fresh, indicating that the pest had been at work for a considerable time, and was still active. As the injury to the apples resembles somewhat that caused by a climbing cut-worm that sometimes infests apples of western New York, I at first searched for caterpillars, and gave little thought to the plum curculios that I frequently found hiding in the pits in the apples. But, after finding a considerable number of the insects in these pits, it occurred to me that they might be the cause of the mischief. Several perfect apples were then selected, and placed in breeding cages, in each of which were confined several curculios. The question was soon settled. Within twenty-four hours the beetles had begun to eat into the apples. They made small holes at first, but these were soon enlarged so as to form pits of the size indicated above."

The substance of this note was reprinted in Bulletin 3 of the Agricultural Experiment Station at Cornell University, together with advance quotations from a then unpublished note from Mr. C. M. Weed, Entomologist to the Ohio Agricultural Experiment Station, in which Mr. Weed states that he was surprised to notice the avidity with which an adult curculio ate a large green plum when confined with it in a breeding jar in June. He also states that he has been informed by Professor Forbes that he has found that the adult curculio eats freely of the substance of the leaves. All these late observations confirm and recall similar experience by the senior author years ago in Missouri.

Number of Broods and Hibernation.—About these two points there has been much confusion among the earlier writers on this insect. Dr. Harris and previous writers believed that the winter was passed in the larva state under ground. Dr. E. Sanborn, in 1849, stated that, in his opinion, the insect hibernates in the beetle state above ground. Dr. Fitch concluded that the insect was two-brooded, the second brood wintering in the larva state in twigs of pear trees, while Dr. Trimble, in his "Insect Enemies of Fruit and Fruit Trees," concluded that it was single-brooded and hibernated in the beetle form above ground. Dr. Trimble's conclusions, which subsequent observations and experiments have proved to be correct, were accepted by later authorities, prominent among whom were Walsh and Riley. The latter, however, in 1867, published an anonymous article in the "Prairie Farmer" for July of that year, over the signature of "V," in which he concluded from the early appearance of adults near Cobden that the insect was, exceptionally, two-brooded, or that it was more frequently two-brooded in the region of Cobden. This communication Mr. Walsh quoted as corroborative of his revised opinion, and in his first report as acting State Entomologist of Illinois, submitted in 1867, entered into an extended argument to prove that the insect is two-brooded, based almost entirely upon the fact that from a lot of plums placed by him in breeding jars the adults issued steadily from July nineteenth to August fourth, and that there was then a period from August fifth to August twenty-second, inclusive, during which no beetles appeared, although on August twenty-fifth they commenced appearing again, and continued to do so daily until September fourteenth. His inference was that the beetles of the latter series were the offspring of those of the former. The flaw in his argument comes from the fact that the beetles of the two series were from two distinct lots of plums, collected at different times, the first series issuing from plums collected June twenty-fourth to June twenty-seventh, from both wild and tame trees, while the plums from which the second series issued were not collected until July twenty-seventh, and were exclusively from wild trees.

Dr. E. S. Hull, in 1868, from his own personal experience, corroborated the views announced by Dr. Trimble, and in the same year, Riley, in his first report on the insects of Missouri, accepted these conclusions in large part, with the reservation, however, that a certain portion of the insects might pass the winter under ground, both in the larva and pupa states, at a depth frequently of from two to three feet. (Walsh had previously accepted the hypothesis of the hibernation in the adult state only.) In his third report, however, Riley fully corroborates Dr. Trimble's conclusions. He conducted extensive and careful experiments which settled the question of the insect's single-broodedness, and he satisfied himself that it invariably passes the winter as a beetle under all sorts of shelter in the woods, generally, however, near the surface of the ground. Indeed, he states that it often makes for itself a hole in the ground, seldom, however, deep enough to more than cover its own body.

The principal reasons for the misconception as to number of broods are found in the fact that an allied species (*Conotrachelus crataegi*) hibernates in the ground in the larva state, and that many adults of *Nenuphar* issue from stung fruit remarkably early in the season, and remain alive until the following spring before ovipositing. Riley, in his third report, mentions individuals which issued from the first peaches the latter part of June, and which he had alive at the time of writing (December second). He also, in this report, called attention to the fact that the adult insects often make a peculiar creaking noise by rubbing the tip of the abdomen up and down against the wing-covers.

NATURAL ENEMIES.

Birds.—Dr. Trimble was probably the first to record the fact that the Baltimore oriole will feed upon this insect, and subsequent observation has confirmed it. Poultry of all kinds will devour the curculio and serve to protect from injury trees growing in ground which they frequent.

Predaceous Insects.—The following predaceous insects have been observed to feed upon the curculio in one or the other of its stages: The Pennsylvania soldier-beetle (*Chauliognathus pennsylvanicus*) in its larva state is one of the most effectual destroyers of the curculio larva within the fruit, whether while this hangs on the trees or after it has fallen to the ground. One of the golden-eyed lace-wing flies (*Chrysopa*) and two ground-beetles known as *Aspidiglossa subangulata* and *Harpalus pennsylvanicus* have also been observed to feed upon the larva.

True Parasites.—The first known parasite of the plum curculio was the Braconid (*Sigalpnus curculionis*, Fitch) described originally in 1861, from specimens bred from black-knot by Mr. D. W. Beedle, of St. Catherine, Canada West. Fitch considered this insect to be parasitic upon the curculio, but there was no positive proof until 1871, when Riley reared a large number from curculio larvæ. Fitch's conclusion had meanwhile been contradicted by other entomologists, and principally by Mr. Walsh, who, in his report as acting State Entomologist of Illinois, endeavored to show that the Sigalphus was parasitic instead upon the larvæ of the little plum moth (*Semasia prunivora*). Riley's observations upon this parasite were very complete. He half filled large jars with pure earth finely sifted, so that no living animal was left in it. Into these jars he placed from day to day curculio larvæ as they issued from peaches, and in due time the parasitic flies began to issue from the ground along with the perfect curculios. He learned to distinguish the parasitized individuals, and was enabled to watch the parasitic larva reduce its victim until nothing was left. After the curculio larva is destroyed the parasitic larva incloses itself in a tough yellowish cocoon and assumes the pupa state, emerging with the adult curculios. During 1871 Riley states that three fourths of the more early developed curculio larvæ were destroyed by this parasite in the vicinity of St. Louis. In that season he reared and distributed a large number of these parasites in different parts of Missouri. This was the same season that Dr. Le Baron experimented in transporting the Aphelinus parasitic on the oyster-shell bark-louse of the apple, and the two are the first experiments of the kind recorded as far as we know. Walsh bred what he considered to be this same parasite from the plum moth, and indeed the genus Sigalphus is not one in which we notice any striking uniformity of habit. The species which have been reared in Europe attack indiscriminately Tinead moths and bark or wood-boring beetles, so far as observed.

The second parasite was originally described by Riley in 1871 as *Porizon conotracheli*, and reared from cocoons sent to him by Dr. Trimble. The species is now placed in the genus Thersilochus, a genus which is closely allied to Porizon, and distinguished by comparatively unimportant characters. This insect works in very much the same way as the one first mentioned, but instead of issuing as an adult the same season it remains in its tougher and somewhat darker cocoon through the fall and winter, issuing only the following spring. This parasite seems to be nearly as abundant in certain sections of the country as the Sigalphus, and probably both are of some assistance to fruit growers. The habits of other species of the genus Thersilochus do not seem to be known, but its close ally, Porizon, is well known as parasitic upon beetle larvæ in Europe. One species has also been reared from rose galls; but here it may also be parasitic upon some inquilinous beetle. Strange as it may seem, we have recently received specimens of the Thersilochus, which were sent to us as new and destructive enemies to plums. They were captured in the act of laying their eggs in the fruit, and the correspondent asked us whether they were not the parents of the white worms so often found in plums and cherries.

For remedies see report Department of Agriculture, 1888. As this insect is not found on this coast, I deem it useless to speak of remedies at the present time.

FULLER'S ROSE BEETLE.

Aramigus fulleri, Horn.

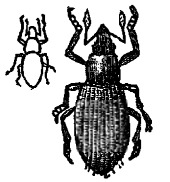


Figure 83.

[A leaf-eating beetle feeding on rose bushes, etc. Figure 83 shows the beetle with the natural size shown on the left.]

This beetle feeds on the foliage of roses, camellias, geraniums, hibiscus, gardenias, azalias, and many other plants, including the orange and the lemon.

The eggs are laid between the bark and the trunk of the plant, near its base, also between the trunk and the ground. Upon hatching the larvæ burrow and begin their feeding upon the rootlets. When fully grown they change to pupæ within the ground, from which the perfect insects emerge, to deposit their eggs for another brood, and to feed upon the leaves. Upon the under side of the foliage and the branches they may be found at rest during the day, as they are nocturnal in their habits, and only leave their concealment after dark for feeding (Lintner).

In the description of this beetle Dr. Horn says: "Beetle—form oblong, oval, surface not densely clothed with dark brown scales. Head and rostrum longer than the thorax, densely punctured, sparsely scaly. Rostrum with feeble ridges on each side from the tip nearly to the eyes. Thorax cylindrical; apex and base equal and truncate; very slightly wider than long, sides feeble arcuate, a fine median line, disc moderately convex, densely punctured, sparsely scaly. Elytra regularly oval; entirely obliterated, base sub-truncate, surface indistinctly striate, and with rows of large, moderately closely placed punctures, intervals flat, not densely scaly, and with very minute suberect hairs; scales dark brown, and whitish or paler stripes beginning at the base. Humerus passing along the lateral margin, ending in a short oblique facia at the middle of the elytra. Body beneath sparsely scaly; legs with scale-like hairs; anterior tibiæ rather strongly denticulate within, articular surfaces of middle tibiæ not ascendant; length 0.26 inch."

Before any person ever again pronounces the Fuller's rose beetle to be the plum curculio, he should study the habits and description given above. It is a serious matter to give an off hand opinion, without any foundation of fact, and should not be tolerated.

Remedy.

The best remedy so far known to destroy this pest is by hunting for the beetles and destroying them. If this is done often, they can be exterminated.

QUINCE CURCULIO.

Conotrachelus cratægi, Walsh.

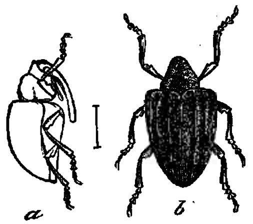


Figure 84.

This is a broad-shouldered snout beetle, and much larger than the plum curculio. It is of an ash-gray color, mottled with yellow and white, has a dusky, almost triangular spot at the base of the thorax above, and seven narrow longitudinal elevations on the wing covers, with two rows of dots between each. Figure 84 (*a*) shows a side view of the insect, and (*b*) a back view.

APPLE CURCULIO.

Anthonomus quadrigibbus, Say.

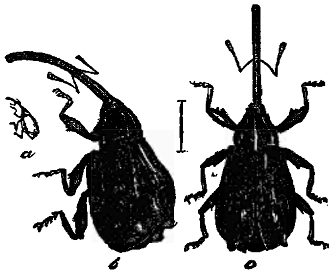


Figure 85.

A small beetle, much smaller than the plum curculio. Color, dull brown, having a long, thin snout, which sticks out more or less horizontally and cannot be folded under the body, as is the case with many species of curculio. This snout in the female is as long as the body; in the male, it is about half that length (Professor Saunders). (*a*) Represents the beetle natural size; (*b*) enlarged, side view; (*c*) enlarged, back view; colors, brown and gray.

PLUM GOUGER.

Coccotorus scutellaris, Lec.

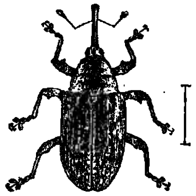


Figure 86.

This insect has some points of resemblance to the plum curculio; however, it is so different as to be easily distinguished. The color of this beetle is (wing cases) brown, with a leaden gray tint; the thorax and legs are yellow; has on its wing cases white and black spots, scattered irregularly over the surface. The beetles make their appearance in the spring. The beetles bore a round hole, like the puncture of a pin, into the plums.

PEACH BORER (CAL.).

Sannania pacifica, Riley.

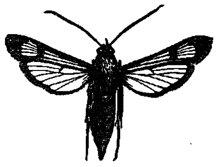


Figure 87.

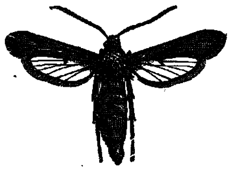


Figure 88.

This insect bores into the trunk of peach trees. They attack the tree just below the ground surface. Figure 87 represents the male; color steel blue, with almost transparent wings. Figure 88, the female; has a larger body; abdomen steel blue. Figure 89, the larva; color whitish, with brown head. When the larvæ are present, they are readily detected in consequence of the exudation of gum; therefore, the trees should be examined early in the spring by removing a little of the earth at the base of the tree, and if masses of gum are found, it indicates the presence of the larva, which if found should be destroyed. It is also well to guard the trees from infection by placing a shake, or some other protection, on the south side of the tree to prevent the trunk from sunburn. A coating of whitewash containing some laundry soap is also effectual. When a borer is removed the wound should be covered over with wet clay, grafting wax, or common laundry soap. Some prefer wrapping the trunk with paraffine paper, and pile up against the paper air-slacked lime or ashes.

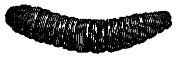


Figure 89.

PEACH MOTH OR TWIG BORER.

Anarsia lineatella.

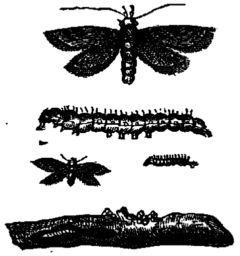


Figure 90.

This insect has given considerable trouble of late years. It attacks peaches mostly, and makes its appearance in the spring of the year. Although troublesome, it is not a very serious pest, as it does not increase as fast as other insects of the same genus. The larva is about a half inch long, and of a light reddish color. The first brood of larva bore into the young limbs and twigs; the second brood bore into the fruit. Peaches have suffered the most, but plums have also suffered. It having been found on plums, was once pronounced the eastern curculio, a species of beetle it does not resemble. It has appeared in some of the fruit districts, and disappeared as strangely as it came. The moth is very small (figures in cut greatly enlarged) and is of a dark-gray color, with a few blackish-brown spots and streaks on the forewings. Figure 90 is a good representation of the larva and moth, natural size and magnified, also a piece of an injured peach twig, showing the channel made by the larva.

Remedy.

The only remedy so far has been to remove the infested branches when found and burn them, but this seems to me impracticable. The summer remedies applied for the pernicious scale have also destroyed the larva of this moth. A grower informed me that this was his experience, and that since he has been using remedies through the summer for scale insects, that it is seldom a peach moth larva or a peach moth is ever found on his place. Other growers attested to similar facts.

PEAR-BLIGHT BEETLE.

Xyleborus pyri, Peck.

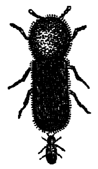


Figure 91.

In the summer, during the heat, the twigs of the pear sometimes become suddenly blighted, the leaves and the fruit wither, and a discoloration of the bark takes place, followed by the speedy death of the part affected.

It has been observed where limbs have died, that a mysterious disease (probably a fungoid) has been the cause of their death, assisted by the attacks of the pear-blight beetle (*Xyleboros pyri*). On examination, the buds at the base will reveal small perforations like pin holes, and from these little holes small cylindrical beetles issue. The eggs are deposited by the beetle at the base of the bud, and as they hatch the young larvæ follow the course of the eye of the bud towards the pith of the stem, around which they pass, consuming the tissues in their course, thus interfering with the circulation and causing the twig to wither. The beetles are about one fourth of an inch long, of a deep brown or black color, with antennæ and legs of a rusty red. (See Figure 91.) The larva changes to a pupa and subsequently to a beetle, in the bottom of its burrow, and makes its escape from the tree in the latter part of June or the beginning of July, depositing its eggs before August has passed, as previously described.

Remedy.

The only remedy that can be recommended is to cut off the limbs when they show a sign of infection, and burn them. They also attack the trunks of trees as well as the limbs, therefore the trunks should be well protected. Young trees (especially when pruned high) generally suffer considerably from the sun's heat through the summer, which causes the sap to ferment and ooze from the bark.

TWIG BORER.

Polycaon confertus, Le Conte.

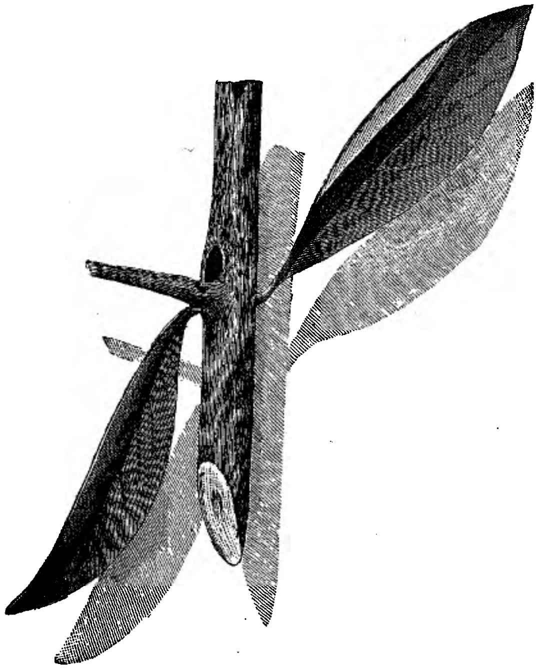


Figure 92.

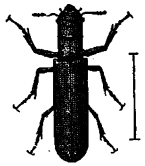


Figure 93.

This beetle is not a new pest, having been found damaging trees in this State as early as 1879. It properly breeds in the oaks, having been first discovered in oak galls. From the oaks it has spread to fruit trees, being especially damaging to the olive; but it does not confine its attacks to that tree exclusively, as it attacks the plum, prune, cherry, apple, chestnut, almond, walnut, etc. During the past two years, young olive trees planted in the neighborhood of oak trees became so badly infested with this twig borer that the growers had about concluded to abandon the culture of that tree. But as it also infests other trees, a change in the future was hopefully looked for. As the trees grow older, they somewhat resist the attacks of this borer, as they put forth new growth, soon after a limb is cut off infested with the borer, thus outgrowing the damage done. Figure 92 gives a good representation of an olive twig, after the beetle has done its work. They generally bore above a twig, and deep down into the pith, and the weight of the limb causes the limb to break at the place where the beetle has effected its escape. Figure 93 shows the beetle, somewhat enlarged. The beetle is about a half inch in length, of a dark pitch color, having on its wing covers small or very minute hairs, and is generally covered with a yellowish powder, which on being removed shows the insect's bright and shining color.

Remedy.

The best remedy so far is to hunt for the infested branches, and to run a wire into the hole, and after working it around several times will kill the beetle. The hole is then plugged up with wet clay, or laundry soap. If the branch does not break down by its weight, it will heal over in time; but, on the contrary, if the limb should break down or show signs of withering, it is best to cut it off, and allow the part cut to heal over.

Spraying with solutions has no effect on the borers, as they are hid inside of the branch, and no remedy can ever reach them. No solution can keep them away, either, because they do not feed on the foliage or bark, and as soon as any solution be applied, they will bore *in* or *out* of a branch without being affected. The solution would kill the larva, if it came in contact with it, but if the larva enters the bark it is then free from any poisoning, as no remedy can reach it.

RED SPIDER OR MITE.

Tetranychus telarius.

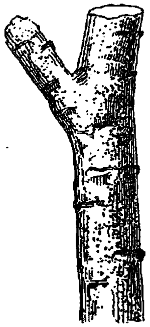


Figure 94.

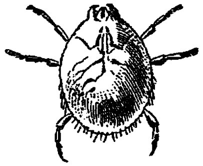


Figure 95.

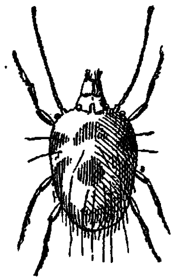


Figure 96.

The red spider or mite is found on various species of trees and shrubs throughout the State. It infests especially the almond, prune, orange, lime, and the lemon. It also infests hothouse plants. Figure 96 shows the adult spider or mite, greatly magnified; color red. Figure 95 shows the larva, greatly enlarged; color bright red. Figure 94 shows a portion of a small limb infested by the spider or mite. This insect is very small, so small that it can hardly be seen without the aid of a glass. They attack the limbs and leaves mostly, but also get on the fruit. It is probably indigenous, as it is found upon the oaks and willows, and also upon the grass and weeds, along our streams.

Remedy.

Strong caustic solutions applied during winter, and the summer remedy given below, have practically exterminated this pest, on deciduous trees.

Summer Remedy.

Sulphur	3 pounds.
Caustic soda (98 per cent)	2 pounds.
Whale-oil soap	25 pounds.
Solution (in all)	100 gallons.

Directions.—Boil the sulphur and caustic soda together in about two gallons of water (this is done to allow the caustic soda to dissolve the sulphur). When the sulphur becomes dissolved, add the soap and boil until thoroughly dissolved, then add water to make in all one hundred gallons of solution, and apply warm.

YELLOW SPIDER OR MITE.

Tetranychus. (Unnamed.)

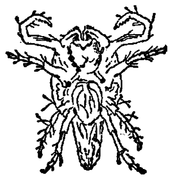


Figure 97.

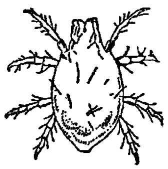


Figure 98.

This spider or mite resembles the red spider (*Tetranychus telarius*) in its attacks and habits, excepting its form and color. It has been very troublesome on plums and prunes. Figure 97 represents the male insect, highly magnified; color yellow, with two bright red spots on the anterior portion of the body. Figure 98 represents the female, highly magnified. This is a very small spider or mite, being scarcely visible to the unaided eye. It spins a web on the under side of the leaves, of threads so slender as to be scarcely visible. Under this shelter will be found mature individuals of both sexes, and young mites of all ages, in great numbers. The leaves attacked by this mite soon show the presence of the mite by their sickly hue (a yellowish cast, with patches of grayish or lighter shade), the sap being sucked by the tiny mouths of spiders or mites.

Remedy.

The best time for destroying these mites is when the trees are dormant, as then the trees can stand the action of strong caustic solutions. During summer, use the remedy used for red spider (see remedy for *Tetranychus telarius*).

XXVII.

ART OF SOAP MAKING IN THE FIELD.

After several years of experimenting, I discovered, and claim to be the original inventor of the process of making soap in the field without the aid of fire or machinery. The process is very inexpensive and simple, and one that any person can follow. In the first place, the required chemicals must be obtained, and no person ought to try and substitute inferior or cheaper ingredients, which has often been done, and the failures never attributed to the carelessness of the operator. The ingredients are as follows, viz.: Lime, which must be fresh and of the best; fish or whale oil, caustic soda (98 per cent), powdered, and commercial potash. In making one barrel of soap, fourteen pounds of potash are suspended in two gallons of water and left over night. The potash next day will become entirely dissolved; then to it the eight pounds of caustic soda are added. The caustic soda being powdered will dissolve very quickly and cause the mixture to become quite hot, and should be stirred gently for a few minutes to allow it to entirely dissolve the undissolved potash. Then let stand, and in the barrel place the five pounds of lime, and on top of it pour the mixture (potash and caustic soda); and as the lime begins to slack stir gently, and if the mixture gets very thick and the heat too great, add a little water and keep on stirring until the lime has entirely dissolved; then add the fish oil (ten gallons) and stir well until it becomes a thick batter; then leave standing two or three hours to allow the oil to saponify. In two or three hours after standing, the oil will have become saponified, and then water can be added, but not too much at a time, as it would cool the mixture all at once; this would cause it to become lumpy, which could not be reduced unless dissolved by heating. A bucket of water is added at a time, and the mixture stirred with a dasher until it has taken up the water; then another bucket is added and stirred in the same way, until the barrel becomes full. The ingredients for this barrel of soap are what has been used during the summer months on peach trees against the ravages of the San José scale and on citrus trees against the ravages of the black and cottony cushion scales. Used one pound to the gallon of water it is very effectual. In dissolving this soap no fire is used; it will dissolve in cold water; but as it hardens somewhat after standing it is much quicker dissolved with hot water—about one bucket to every hundred pounds of soap. The soap is placed in a barrel and the water poured on top of it, and by stirring with a dasher will dissolve very readily. This mixture must be applied cold, because if it is heated the combination will lose its properties. It is in this state that they are effective, because the ingredients remain in a state that, if fire be used, it would turn them into something else and destroy their effectiveness. When applied in this state on trees, the solution is in a form that when the sun strikes the tree it will soften and penetrate into and under places where it otherwise could not. It is also in a state that it cannot do any injury to the fruit or foliage.

XXVIII.

FUNGOID DISEASES.

Next to the damage done by injurious insect pests, fungoid diseases rank second on the list of destructive agents. Such diseases as eastern peach yellows, plum pockets, brown rot of the cherry, rust of the orange, root rot, black rot, etc., have never made their appearance in this State. In the Eastern States fungoid diseases have been the cause of very heavy loss to fruit growers, annually. In most cases the history of the fungi which cause these diseases is but little known, and their entire history should be carefully studied.

Of late years the Section of Vegetable Pathology (Reports Department of Agriculture, 1887–8) has carried on very extended investigations on the fungoids found on this coast, extracts of which are herewith appended, for which I make due acknowledgment.

PEAR CRACKING AND LEAF BLIGHT.

Entomosphorium maculatum.

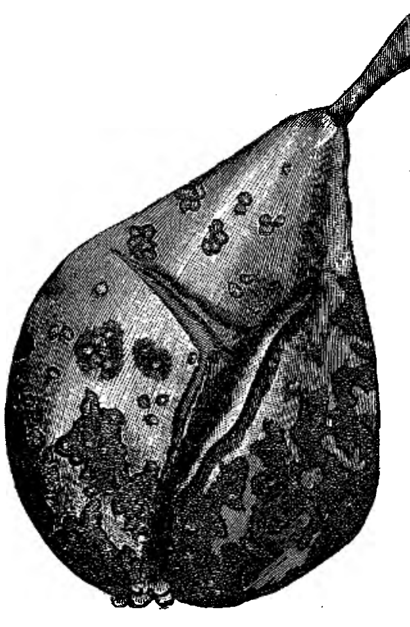


Figure 99.

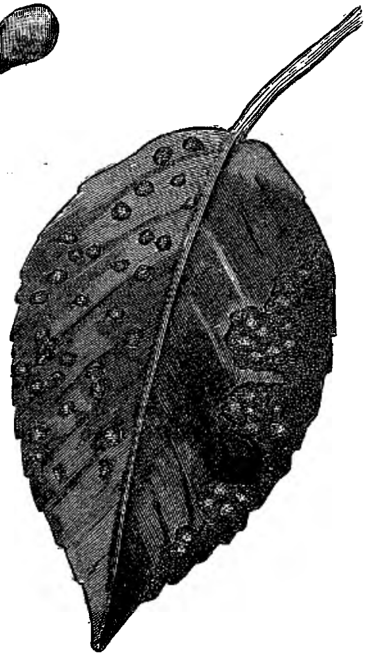


Figure 100.

During the past year the Section has received many inquiries concerning a disease long known to horticulturists as "leaf-blight" or "scald" of the pear tree. It is quite distinct from the ordinary "pear-blight," and affects the fruit and wood, as well as the leaves. It is extremely destructive in some parts of the country, and merits special attention. * * *

Hosts.—The disease is not confined entirely to the pear, although it is on this that it most concerns farmers and fruit growers. It also attacks the *Cydonia* (quince), *Cotoneaster*, and *Mespilus*. Nearly every variety of the pear is subject to it, but some are more liable to its attacks than others.

Mr. F. S. Earle says that "out of an experimental orchard of a hundred and twenty varieties planted at Cobden, Illinois, all but ten or twelve were so badly injured as to be discarded as worthless." In a letter, from which we have before quoted, Colonel A. W. Pearson says: "The Kieffer seems to best withstand the fungus. * * * The varieties most damaged are the Sheldon and Beurre Clairgeau. Both of these have been an entire loss for four years past. Every fruit has shriveled and cracked." In quotations already made from letters of F. S. Earle and W. W. Thompson, it is evident that the Le Conte and Louis Bonne are also very liable to attacks. From our own observations we conclude that Louis Bonne, Bartlett, Seckel, Bosc, Clapps, and Roestiezer are never entirely free from the disease, and are usually badly attacked, while Anjou, Duchess, Lawrence, Flemish, and Vicar may be mentioned among the varieties most exempt.

Geographical Distribution.—As has already been shown, the pear and the fungus have nearly the same distribution. The disease has been reported on various hosts from Germany, Sweden, Italy, and France, and in this country it is very widespread.

History.—It was first discovered by Chaillet on living leaves of *Cotoneaster tomentosa* and *Mespilus germanicus*—two plants related to the quince and pear—and named *Xyloma mespili* by De Candolle. Morthier afterwards found it on the first named plant, also on *Pirus communis* and *sylvestres*, and Fuckel found it on *Cotoneaster vulgaris*. Fuckel gave it the name *Morthiera mespili*, including the fungus as found on all the above named hosts, and by this name it is still generally known. Saccardo, however, published only the form on *Mespilus germanicus*. Ellis and Cooke, on the other hand, founded the variety *Cydoniæ*, occurring on quince leaves and fruit, upon Fuckel's *Morthiera mespili*. Léveille changed the genus to *Entomosporium*, and made two species, one *Entomosporium maculatum*, including the form on *Pirus communis*, and the other *Entomosporium brachiatum*, comprising the fungus on *Cotoneaster* and *Pirus sylvestris*.

In his Sylloge Fungorum, Saccardo attempts to reconcile these conflicting authorities as follows: He includes under *Entomosporium maculatum*, Lév., on *Pirus communis*, the following varieties: (*a*) *Domesticum*, equal to his former species (*Morthiera mespili*, Sacc.) on *Mespilus germanicus*; (*b*) *Cydoniæ*, E. & C., on quince; and he changes *Entomosporium brachiatum*, Lév., to *Entomosporium mespili* (DC.).

The two species are founded merely on a difference in size of the spores. According to Fuckel the conidia measure 14 by 18 μ. Sorauer gives the largest spores on *Pirus communis* as 22.5 by 10 μ, and Saccardo gives the following:

E. maculatum, conidia 18–20 by 12; pedicel, 20 by ¾ μ.
var. *Domesticum*, conidia 18 by 8; pedicel, 15 by ¾ μ.
var. *Cydoniæ*, conidia 12–15 by 6–7 μ.
E. mespili, conidia 25 by 15; pedicel, 20 by 2½ μ.

A careful comparison of these measurements will arouse some doubt as to their value as a basis for establishing species. Fuckel's and Saccardo's measurements might indicate some constant differences in size between the two species, but Sorauer's measurement of 22.5 by 10 μ on *Pirus communis* does not fall much short of Saccardo's 25 by 15 μ on *Pirus sylvestris*, and according to Saccardo's own measurements there is more difference between the species *E. maculatum* and its var. *Cydoniæ* than the two species *E. maculatum* and *E. mespili*.

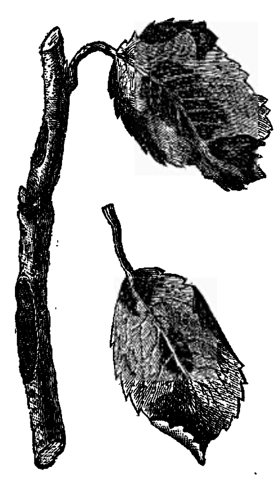


Figure 101.

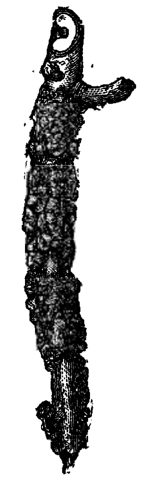


Figure 102.

[Figures 101 and 102 show the effect of the fungus on pear branches and leaf. Figure 101, a one-year old twig. Figure 102, a two-year old branch.]

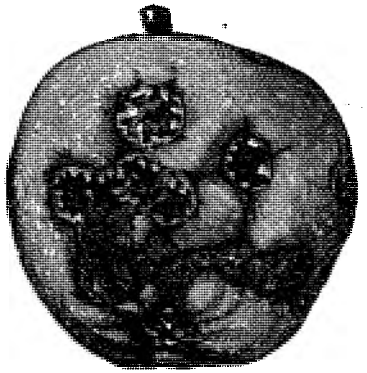


Figure 103.

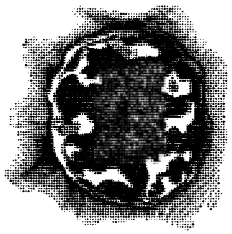


Figure 104.

[Figure 103 shows the work of the fungus on the apple. Figure 104 shows a blotch enlarged.]

Furthermore, measurements of spores from the cultivated pear, made in this department, indicate that their size may exceed the largest measurement given by Saccardo for *E. maculatum*. In fact, the founding of species on the size of spores, especially when the differences are so slight as in the present instance, needs repeated observations and measurements under varying conditions before much dependence can be placed upon it; and this is one case where the required number of observations have not yet been made. In fact, even if the variations given prove to be constant, it still remains to be proved whether they are not due simply to a change of host. The question is an extremely practical one, for, if farmers must expect infection from sources outside their own and their neighbors' pear trees, it is necessary that they should know it.

In Europe the fungus has been known for nearly a century. De Candolle mentions it in 1815. In this country the injury resulting from the disease has been discussed by fruit growers for many years. In "Barry's Fruit Garden" for 1863, the author, in speaking of the difficulty connected with the growing of pear seedlings, says:

> This difficulty is owing chiefly to a species of rust or blight that attacks the leaves of the young plants, very often before the latter have completed their first season's growth. * * * It appears on the leaves in July or August first as small brown spots; these spread rapidly over the leaves until they are completely dried up and growth is stopped. Whether it is an insect or fungus, or some atmospherical cause, that produces this blight is unknown. Certain causes favor one or the other of these opinions. More minute investigations are wanted on the subject.

External Characters.

The disease makes its appearance early in the spring soon after the development of the leaves. It first shows itself in the shape of small, dull, carmine-red spots, which appear first on the upper, and finally penetrate to the lower surface of the leaf; the color soon changes from red to a dark brown, with a slightly elevated, minute, black spot in the center. The spots also increase in size, and if they are very numerous, as is most often the case, the tissue between them also turns brown and loses its vitality. If the leaf is young or belongs to a delicate leaved variety it shrivels up by the contraction of the diseased portions; but if it is mature and consists of firm tissue it retains its shape, the only change being in the color. As soon as the leaf becomes badly diseased it falls off; and if, as often happens, another growth of leaves is produced, these too become diseased. The spots are usually about .11 of an inch in diameter.

Trees seriously attacked by this disease can be distinguished at a distance by their defoliated appearance. This wholesale destruction of the foliage interferes very seriously with the growth of the wood and the maturing of the fruit, for the leaves are the organs which transform the food material that is brought up from the roots and absorbed from the air into a form in which it can be directly used by the plant in the making of wood and production of sugar in the fruit.

But, in addition to this, the fruit and stems themselves often become diseased. The fruit also shows the carmine-red spots, which afterwards become dark colored. The skin becomes very much roughened, and the growth of the epidermis over the diseased portion is checked, causing a crack which extends deeply into the flesh, so that, even if the fruit can obtain sufficient sugar to mature properly, its appearance is spoiled and the cracking makes it liable to decay.

The development of the fungus on the branches does not differ materially from what takes place on the leaves. There first appear small circular spots on the young bark; these gradually become elongated and somewhat depressed, with a slight elevation in the center, and their color changes to a shining brownish black. Frequently the stem is completely girdled by these diseased areas, and, as a result, the end of the branch dies above the point where the fungus is present. The petioles and leaf scales are also often diseased. Indeed, there seems to be no part of the tree above ground, that is in active growth, quite exempt from the attacks of the parasite.

Microscopic Characters.

The small black specks in the center of the brown spots comprise the fruiting portions of the fungus. The fruit is at first covered by the cuticle, but this is finally ruptured, exposing a layer of spores borne on a thin stroma. The spores or conidia are analogous to the seed of higher plants; they have an exceedingly characteristic form, and may always be recognized without difficulty. When mature they consist of from four to six cells, and are borne upon a pedicel or stalk. Their development is as follows: Short branches, consisting of three or four somewhat elongated cells, grow up from the stroma. The upper cell first shows an enlargement, and this is followed by the second one, which usually constitutes the lowest cell of the conidium, the remaining ones forming the pedicel. From the upper one of these cells grows out a fine, upright bristle, which is about the length of the cell itself. It has distinct walls and contents, as may be seen by staining with iodine. Before these two cells are fully developed, small buds may be seen growing out on the lower one, close to its point of contact with the upper. These vary in number from one to four. They grow out obliquely, so that they are in contact with the upper cell. In size they are much smaller than either of the others. From these in turn there grow out bristles, but in this case the bristles are on the backs of the cells and are directed horizontally or obliquely. Occasionally three cells of the original filament swell up to form the conidium, and in this case both the lower cells may bear buds, or the lower one may branch and bear another conidium, so that one pedicel bears two conidia.

When the conidia germinate the cells enlarge somewhat and the bristles swell up at the base; the colorless, and sometimes septate, germ-tube frequently emerges in the vicinity of the bristle. When germination takes place on a leaf the germ-tube bores through the epidermis and develops a mycelium within the tissues.

The mycelium is composed of short cells forming colorless branching filaments. It is very abundant and is everywhere easily seen between the cells of the body of the leaf (Fig. 100). When young it penetrates the epidermal cells only, but Sorauer says that when it is old it becomes darker colored and can be seen within the cells of the mesophyll; and Ericksson states that he has found Sorauer's observations true in every respect. The mycelium masses itself together in places between the cuticle and epidermis, forming a thin stroma on which the conidia are borne. Below the stroma the mycelium seems at first to pass mainly between the epidermal cells, but it finally breaks them down so completely that the walls and contents can with difficulty be distinguished. The cuticle is finally ruptured by the pressure of the stroma and young spores, and the conidial layer is exposed to the air. Sorauer says that on August 4, 1876, the upper surface of the leaves of five one-year old pear seedlings were inoculated with these conidia and placed in moist air under bell jars. Three of the inoculated leaves, on two plants, showed the characteristic circles at the points of inoculation August nineteenth, and a conidial pustule in September, giving about a month for the complete circle of reproduction.

In addition to the conidia Sorauer has also found what he considers the ascosporous or winter stage of the fungus. The following is abridged from his account:

> An investigation of the diseased leaves in December will disclose brown capsules on the tissues in addition to the still living conidial layers. These capsules (perithecia) I consider as the fruit of *Morthiera*, which attains maturity in May and June. The perithecia vary considerably in size. They are dark brown, globuse or depressed from above, usually solitary, sometimes in groups of several ranging from 75 μ to 175 μ, and in some

instances to 200 μ in diameter. They are usually found either on the upper surface between the separated palisade cells or between these cells and the epidermis. In the first case they are not recognizable on the outside. In the latter there is a distinct swelling caused by the epidermis being lifted up by the growth of the capsule. The brown wall of the capsule varies in thickness, the greatest width being about 7.5 μ. In January the best developed perithecia contain at their bases a mass of white, stromatic, small-celled tissue, from which arise numerous nearly upright, slender threads ranging from 1.5 μ to 2.5 μ in diameter. These are the young asci.

The asci are club-shaped, with a double contour, much the largest in the upper third of their length, and contain eight colorless, crowded ascospores, in two rows. They are somewhat shorter than the paraphyses, and at maturity are obtusely conical in the upper portion, the point being drawn out into a papilla. This projecting point opens, forming a circular aperture through which the spores are discharged one after another.

The paraphyses arise in a tuft from the base of the capsule; they are filiform to club-shaped or globose at the apex, and are occasionally borne in pairs on one pedicel.

The spores are acute ovate to obtuse club-shaped, divided into two parts by a transverse septum sometimes slightly curved and somewhat constricted at the partition. When seen in large numbers the ripe spores have a pale, yellowish-brown appearance. They sometimes germinate while still in the ascus. In germination the hypha usually proceeds from the smaller end.

Their germination was observed in May at about the time the first diseased spots appeared upon the new foliage. So that if the conidia fail to carry the fungus over winter, or if they do not find a lodgment on the young stems, the ascosporous fruit will pass the winter unharmed and be ready to begin its work with the unfolding of the leaves.

Sorauer further classifies the fungus as a *Stigmatea*, and gives it the specific name of *mespili*.

So far as known to us this has not been verified by any other observer.

There are several other fungi found associated with the *Entomosporium* on the pear and quince. They are frequently found on the same spots with *Entomosporium*, but are often quite separate from these spots; it is especially frequent where the leaf is so badly diseased that the tissues are nearly all dead.

At first they appeared so closely connected with the *Entomosporium* that it seemed as if they might be the spermogonial form, but a closer examination revealed morphological differences in the mycelium. That of the spermogonial form is darker colored, thicker walled, contains distinct globules, and is not so closely septate or abundant. Moreover, this form is often widely separated from the conidial form of the *Entomosporium*. It is probably saprophytic in its nature, coming on the leaf after the *Entomosporium* has killed it. These capsules are found alike on both sides of the leaf, but more often on the upper side. They consist of a single layer of dark colored pseudo-parenchyma, lined with a little colorless tissue on which are borne chains of minute rod-like bodies. These are so small that they partake of the Brownian movement.

Treatment.

It is difficult at any time to treat large trees, but as this fungus causes the greatest injury to young ones, and especially those growing in nurseries, a course of treatment that would be of use in the latter place alone would be of great value. From what we know of the life history of the fungus, it is evident that burning the fallen leaves would serve as an important means of removing a source of infection. With regard to the proper time to do this, it is probable that the best results will follow if the leaves are raked together and destroyed as soon as they fall; in other words, it would not be advisable to allow such leaves as may fall in midsummer from the effects of the malady to remain on the ground under the trees until the following autumn or spring. They should be destroyed as quickly as possible, before any of the spores have had an opportunity to escape.

Patrick Barry,* speaking of this disease, says:

To obviate the difficulty which this malady presents (in the nursery), a vigorous growth should be obtained early in the season. New soil, or that in which trees have not before been grown, should be selected. An old pasture is the best. The autumn before planting it should be trenched or subsoil-plowed to the depth of two feet, for the pear has long tap-roots, and liberally enriched with a compost of stable manure, leaf mold, or muck and wood ashes in about equal parts; four inches of this spread over the surface before plowing, will be sufficient for ordinary soil. Lime should also be given liberally, unless the soil be naturally and strongly calcareous. A soil prepared thus in the fall will require another plowing or spading in the spring, to mix all the material properly with the soil and fit it for the seeds. If the soil be very tough, and not fit to be turned up, a thorough harrowing or working with the horse hoe will do. Where large quantities are grown, the drills may be the same distance apart as that recommended for apples—three feet; but if only a few, twelve to eighteen inches will be sufficient, as the cleaning can be done with the hoe. The seeds should be scattered thinly, so that every plant may have sufficient space without any thinning. The end to aim at, as before remarked, is to get good growth, say eighteen or twenty inches in height, and stout in proportion, before the first of August. This can be done in any deeply trenched or plowed fresh soil, well prepared and manured, as described above. I have been told that seedling pears grown in a frame covered with whitewashed sash, and kept well ventilated continually, escaped the "leaf-blight," whilst all those grown in open ground near by were blighted.

In addition to the foregoing it is very probable that the development of the fungus upon the leaves or other parts of the plant may be prevented by the application of some fungicide, although no experiments having a bearing upon this question have, as far as we know, been undertaken. Since the spots make their appearance as soon as the leaves have attained full growth, the application must be made early so as to prevent the spores from germinating. In no case should the application of the remedial agents be postponed until the fungus has made its appearance upon the leaves, for if this is done it will be of little use to apply them.

Where the disease prevails more or less every year it would be well to thoroughly spray the trees, before the buds begin to swell, with the Bordeaux mixture, prepared as follows:

Dissolve sixteen pounds of sulphate of copper in twenty-two gallons of water; in another vessel slake thirty pounds of lime in six gallons of water. When the latter mixture has cooled pour it slowly into the copper solution, care being taken to mix the fluids by constant stirring.

When the leaves are about two thirds grown a second application should be made, this time, however, using a solution containing the ingredients in the following proportions:

Sulphate of copper	6 pounds.
Lime	6 pounds.
Water	22 gallons.

Dissolve the copper in sixteen gallons of water and slake the lime in six gallons, then mix as described above.

The object of the first spraying is to destroy any spores of the fungus that may have survived the winter in the crevices of the bark, while the second and weaker application is obviously for the purpose of preventing such spores as may fall upon the young leaves from germinating. It would be well to repeat the applications of the weaker solution every three or four weeks until the last of July or middle of August. The same preparations mentioned above may be used to protect the leaves of seedling pear trees against the ravages of the parasite, but in this case the first application of the Bordeaux mixture, second formula, should be made about the middle of June, followed by a second two weeks later, and a third the latter part of July. If this course of treatment is properly carried out we have little doubt that the plants will preserve their leaves throughout the season, and thus be able to complete their growth, making good stocks either for budding or grafting.

---

*Fruit Garden, p. 127, revised edition.

CHERRY, PEACH, AND PLUM RUST.

Puccinia pruni-spinosæ, Pers.*

General Observations, Distribution, etc.

The leaf rust here described is widespread in this country, having been observed in nine States, including Massachusetts, Florida, Louisiana, Texas, and California, a fact which would indicate a very general distribution. It is also known in Germany, France, and Great Britain. In the first named country it is popularly called the "rust of the stone-fruit trees."

With us it is most generally found upon the plum, but occurs also on the cherry, apricot, and peach. It has been described as the "plum tree brand."

The fungus producing the rust has been described under several different names; that used here is the one adopted by Winter. Some confusion has probably arisen from the fact that the uredo stage alone occurs upon the peach and from the resemblance of the uredospores to the teleutospores of *Uromyces*.

The uredospores may or may not be present on the plums, but on the specimens examined a few have been found in all cases mingled with the teleutospores. Some leaves gathered in Aiken, S. C., in April, had nothing but uredospores, but they seem to persist until winter, as specimens collected December twenty-sixth, in Texas, still showed a large number. The climate may, of course, have something to do with their presence.

External Characters.

The appearance of the diseased leaves differs according to the species attacked. On the peach small, round, powdery spots of a yellowish brown color make their appearance upon the lower surface of the leaf, and directly opposite these, upon the upper surface, the tissue turns reddish yellow. So far as known this appearance does not change throughout the year, except that as the spots grow older they may turn brown upon the upper side. The plum may have similar spots early in the season, but later these are mingled with dark, purplish-brown, powdery spots below, and above they may be yellow or dark brown. The spots are irregularly scattered over the leaves and sometimes confluent.

Microscopical Characters.

The fungus of this disease, like that of the beet rust, belongs to the family *Uridineæ*, but in this case the æcidio-stage of the parasite is not known. The known spores, which have strongly marked specific characters, are formed upon a stroma beneath the epidermis, which they finally rupture, and they, together with the stroma, project slightly above the surface. The spores are interspersed with paraphyses, having expanded globular tips with walls thickening at the apex, giving them the appearance of immature uredospores. The uredospores are light yellow in color and of a very irregular form, varying from club-shaped to oblong, but are most often obovate; the walls are thin except at the apex, where they are greatly thickened; the surface is echinulate, but the spines diminish in size towards the apex, and are scarcely visible upon the thick part of the wall; the endospore is pierced by two germ pores situated just below the thickened portion of the wall.

---

* The more important synonyms are *Puccinia prunorum*, Lk., *Uredo prunastri*, D. C., and *Uromyces prunorum*, Fckl.

The teleutospores are dark-brown, two-celled bodies, so strongly constricted in the middle that the cells are usually about the same size, but the upper one is sometimes larger, and the lower may be colorless in some cases. The wall is of uniform thickness, and is covered with short, thick spines, set very close together.

Both teleuto and uredospores have comparatively short pedicels. The former have never yet been found upon the peach, and it is probable that they do not occur upon it at all, since specimens gathered in Texas as late as December twenty-sixth failed to show any.

In regard to the disastrous effect of this fungus on the peach, a Texas correspondent writes, October eighteenth, that "the fungus caused nearly all the leaves to fall within the last four weeks, even the second growth."

The wild as well as the cultivated plums are attacked, a fact that will render infection of cultivated trees certain when there are diseased native ones in the vicinity.

Treatment.

Little can be said in way of treatment, and all experiments in this line must be wholly empirical. As stated above, we do not know the first or æcidio-stage of the fungus, and it is not certain that this stage is necessary for its continued propagation. The parasite is endophytic, or grows within the tissues of the leaves of the host plants, and by the time it has become visible on them by its production of spores, the body of the fungus has already attained considerable growth and is beyond the reach of fungicides. We can only hope to keep the disease off the trees by preventive applications, and in localities where some treatment seems to be imperative we suggest spraying the foliage with some of the sulphate of copper solutions, eau celeste for example, as being most likely to be protective. Very dilute solutions of chloride of iron may also protect the trees from the attacks of this parasite.

CHERRY POWDERY MILDEW.

Podosphæra oxycantha.

Among the parasitic fungi which attack cultivated plants the powdery mildews or *Erysipheæ* hold a prominent place; the native vegetation is also much infested with them and it is very probable that in many cases they have been transferred from the latter to the former. Like many of the members of this group the powdery mildew of the cherry attacks plants belonging to several genera, and it is also somewhat variable in its microscopic characters. These facts have led botanists to give it a number of names.

History.—It was first named and described by De Candolle,* who found the species on the hawthorn (*Cratægus oxycantha*) and called it *Erysiphe oxycanthæ*. Later DeBary † with a different understanding of the genus changed the name to *Podosphæra oxycantha*. Wallroth,‡ a German botanist, described the same fungus on the species of *Prunus* (cherry) as *Alphitomorpha trydactyla*, and DeBary‖ afterwards made this name *Podosphæra trydactyla*. The form on the huckleberry (*Vaccinium*) was also described as distinct and named *Podosphæra myrtillina* (Schubert) Kunze. The form on *Spirea* was considered a good species and named *Podosphæra minor* by

---

* Flore Franc., VI, p. 106.
† Beitrage III, p. 48.
‡ Flore Crypt. Germ., III, p. 753.
‖ Beitrage III, p. 48.

Howe.* Earle, in a revision of the American forms of *Podosphæra* and a comparison of the European, has shown† that all these belong to one widely variable species, whose characters nevertheless are as well defined as several other species of the group. Still later Miss Martha Merry‡ demonstrated that the so called *Microsphæra fulvofulcra*, described by Cook from California specimens on *Spirea*, is identical with the form on the same genus of host plants called by Howe *Podosphæra minor*. In the selection of the name for the species as a whole the oldest available name, *Podosphæra oxycantha*, the one for the form on *Cratægus*, was chosen.

Host Plants and Distribution.—This fungus occurs commonly in the eastern and central portions of the United States, and is reported from the Rocky Mountains and California.

Young cherry trees are the chief sufferers from its attacks, but it also does considerable harm to the peach and to young apple trees in the nursery, and occasionally seriously injures the quince. It is of very common occurrence, but fortunately does not usually get under headway until the trees have made their growth and are past serious injury. The fungus has been found on the following host plants, all of the order Rosaceæ, except the species of *Vaccinium* and persimmon:

Red cherry (*Prunus cerasus*), garden plum (*P. domestica*), wild red cherry (*P. pennsylvanica*),‖ wild red and yellow plum (*P. americana*), small bird-cherry (*P. padus*), sloe or blackthorn (*P. spinosa, P. demissa*), choke cherry (*P. virginiana*), peach (*P. persica*), apple (*Pirus malus*), crabapple (*P. coronaria*), quince (*Cydonia*), English hawthorn (*Cratægus oxycantha*), hardhack (*Spirea tomentosa*), meadow sweet (*S. salicifolia*), Douglas' meadow sweet (*S. douglasii*), shad-bush (*Amelanchier canadensis*), blueberry (*Vaccinium myrtillus, V. uliginosum*), persimmon (*Diospyrus virginiana*).§

External Characters.

The disease has been observed in Missouri as early as the first of June,¶ but usually it does not develop sufficiently to attract attention until July. During the latter part of summer and autumn it reaches its greatest development. It is first noticeable on the young leaves and tender shoots as small, round, or irregular, whitish blotches, having a radiated appearance. The spots soon spread and run together, covering indefinite portions of the foliage, or more often running over the entire leaf. As the fungus spreads the radiated appearance disappears. The threads meantime branch profusely and cross each other in all directions, forming an even white felt which may be very thin or so dense as to entirely conceal the green color of the leaf. The denser portions then become covered with a whitish powder, and still later the threads give rise to minute, black, spherical bodies just visible to the naked eye. The fungus grows on both sides of the leaf, in some cases indifferently on either surface, but usually a decided preference is shown for but one. On one tree the upper side of the leaves will be badly infested, while the under side will have scarcely a trace of it; another tree, perhaps in the same orchard, and only a few feet away, will be badly mildewed on the under side, with little on the upper. Frequently the black spherical fruits of the fungus are found abundantly on the leaves, usually the under side, with only a very scanty development of the white threads.

---

* Bulletin of Torrey Botanical Club, V, p. 3.
† Botanical Gazette, IX, p. 24.
‡ Botanical Gazette, IX, p. 189.
‖ Found by the writer on this host in Illinois, September, 1888.
§ Rose, J. N. Botanical Gazette, XI, p. 61.
¶ Galloway.

From this condition very little damage results to the plant, and it does not present the characteristic mildewed appearance. Probably in this instance the leaf is pretty well matured before the fungus attacks it. On the other hand, the principal damage to fruit trees results from the attacks on the growing tips and young leaves. Here the coating of the fungus is usually quite pronounced, and the mealy appearance mentioned above is most prominent. This most destructive form of the fungus usually bears but a few of the spherical spore cases, and often fails to produce any before frosts put an end to the season's growth.

Botanical Characters.

The white felt which creeps over the surface of the leaves is the vegetative portion or plant body of the parasite. It consists of slender, branching, septate, white threads, and is termed the mycelium. These filaments are about 4 μ† in diameter. They do not penetrate the host, but send down small suckers, called *haustoria*, into the epidermal cells. The fungus is entirely destitute of chlorophyll, and depends wholly on the plant upon which it grows for its support. The haustoria absorb the juices from the host cells and transmit the material to the mycelium, where it is used in the development of the fungus. As the development of the parasite proceeds certain rather thick branches, called *conidiophores*, arise from the mycelium and assume a vertical position. A transverse partition forms near the end of a branch, and the cell so isolated becomes somewhat rounded, and finally falls off. The spore thus formed is called a conidium. In the meantime similar partitions have been forming successively from the end of the filament downward, so that conidia occur in all stages of formation and give to the conidiophore a moniliform appearance.

Some of the conidia reach a suitable place for germination and start the fungus in a new place. As the conidia are exceedingly small, they are carried about by currents of air, or by insects, to adjoining trees.

These spores serve for the rapid spread of the fungus during summer. Later in the season—usually during summer—the dark-colored spore-bearing bodies, called *perithecia*, develop at points where two filaments cross. Like the seeds of higher plants, their development is the result of an act of fertilization.

The young sporocarp or perithecium is colorless, or nearly so, but as it grows larger it becomes yellowish, finally brownish, and when mature it is very dark brown, or nearly black and opaque.

The fully developed perithecium is spherical when viewed from above; but the side towards the leaf is much flattened, so that the object represents slightly more than half a sphere. The surface is covered with numerous reticulations, which indicate the cells of which it is made up. Each cell is rounded outward, so that the perithecium is covered with hemispherical protuberances, or blunt conical projections. From some of the cells of the upper part of the perithecium arise peculiar outgrowths or appendages, characteristic of the *Erysipheæ*. They are septate, that is, consist of several cells, the lower of which are tinted brown, while the upper and longer cell is colorless. This ends in a peculiar dichotomously branched tip. While many of the appendages are highly developed and several times branched, others have this character but slightly developed, or entirely wanting, and end in a blunt point. The appendages vary in number from eight to twenty; sometimes there are only three or four. They are usually arranged in a circle around the upper part of the perithecium, but are sometimes clustered at the top and extend upward in an oblique direction. The perithecium contains a single large, transparent spore sack, called an *ascus*, in which may be seen eight elliptical ascospores. With the exception of thin places in the walls of the asci at each end, there is no provision for the escape of the spores, except by the breaking up of the perithecia the following spring from decay.

---

† One $\mu = \frac{1}{25000}$ of an inch.

Little has been ascertained concerning the germination of these spores or the process by which the fungus first starts on the leaf.

In many of the specimens examined small bodies were found, resembling perithecia, but more delicate, thinner walled, lighter colored, and made up of smaller cells. These are not of a constant size or shape, but are usually ovate or elliptical, and under pressure discharge from the apex numerous small elliptical spores. They were supposed, for a long time, to be a part of the fungus, that is, one kind of its spore-producing bodies, but are now known to be a parasite on the mildew. We have here, then, a case of a parasitic fungus growing on another parasitic fungus. This parasite was first discovered by Cessati, who found it in connection with the grape mildew, and called it *Ampelomyces quaqualis?* This opinion was overruled, and the fungus was considered one of the fruiting forms of the mildew, until DeBary investigated it and demonstrated that it was a parasite on the mildew, and not a part of it. DeBary named it *Cincinobolus cessatti*. It occurs on various species of *Erysipheæ*, and was found quite commonly on the specimens of *Podosphæra* examined. In one instance a leaf, supposed to be covered with the perithecia of *Podosphæra*, showed, upon examination, only the smaller, lighter colored perithecia of *Cincinobolus*. In many instances it doubtless greatly prevents the spread of the mildew.

Conditions Favoring the Development of the Fungus.—The members of this family thrive best during warm, dry weather, and the species under consideration seems to be no exception to the rule. In the Mississippi Valley vegetation suffered greatly from drought during the years 1887 and 1888, and in consequence the mildews had an unusual opportunity for development. In the latter year the cherry fungus was very abundant in Illinois, doing considerable damage to young trees. A light rain, giving the conidia a chance to germinate, followed by a long dry spell, is probably the best time for the fungus to develop. On the other hand, seasonable rains, and other conditions favoring the proper growth of vegetation, are probably the conditions least favorable to the parasite. It is a question whether the greater development of the mildews during a dry season is due to the direct action of these conditions on the fungus itself, or whether the explanation is to be found in the weakened vitality of the host. Both these influences must probably be taken into account. Plant parasites, however, have a way of appearing very abundantly in certain seasons and in certain places without any evident reason.

Treatment.

On account of their manner of growth, which, as we have seen, is almost entirely on the outside of the leaves, the powdery mildews are easily reached and destroyed by fungicides. So far as we are aware, no experiments have been made with the view of finding a remedy for the species under consideration, but as the powdery mildews are much alike in their structure and mode of growth it is reasonable to suppose that the treatment would be similar for all.

Sulphur, as is well known, has been successfully used in the treatment of the powdery mildew of the grape and rose, and it would no doubt be a successful remedy for this species. The material must be in a finely powdered condition, and be dusted over the diseased plants.

From the numerous liquid fungicides the following have been selected as most suitable for use in this case, principally on account of their success in combating the mildew on the grape and rose. They are recommended in the order in which they are given, and should all be applied to the plants in the form of a fine spray:

Sulphuret of Potassium (potassium sulphide).—Simple solution in water; about one half ounce to the gallon. Experiments conducted by the Section this year (1888) show conclusively that this remedy will not only prevent the powdery mildew of the grape, but will destroy it when under headway. At the New York Agricultural Experiment Station, during the present year, Mr. E. S. Goff has found it successful in the treatment of the gooseberry mildew.

Liquid Grison.—Prepared by boiling six pounds of sulphur and three pounds of lime in six gallons of water until the whole is reduced to two gallons. Allow to settle; pour off the clear liquid and bottle it until used. For use mix one part of the liquid with one hundred parts of water.

ROSE RUST.

Phragmidium mucronatum.

The rust of roses is a disease which has been known to botanists and horticulturists for nearly a century. The minute parasitic fungus causing the malady was first described by Schrank,* a European botanist, under the name of *Lycoperdon subcorticium*. Many later botanists have described it under various names.†

For a long time it was retained in the genus *Puccinia*, but Link, in 1825, placed it in the genus *Phragmidium*, where it still remains.‡

This parasite is common in Europe and is widely distributed in this country, attacking both wild and cultivated plants; in severe cases the death of the host is the result. It has recently been observed in California, by Professor S. M. Tracy, infesting to an injurious degree hybrid perpetual roses. In one instance a Maréchal Niel, growing in a greenhouse, was very badly affected. Tea roses rarely suffer from its ravages; it is the hardy, hybrid perpetuals that suffer most.

External Characters.

Early in summer the disease first makes it appearance on the leaves, leaf petioles, or young stems, in the form of variously-shaped lemon-yellow

---

*Hopp's Bot. Taschb., p. 68.

†*Ascophora disciflora*, Tode, Mcke. Fung., page 16. *Aregma mucronatum*, Fries. Obs. Myc., I, page 225. *Phragmidium incrassatum* var. *rosarum*, Walla., Flor. Germ. Crypt., IV, page 188. *Phragmidium mucronatum*, Lk., Spec. Plant, II, page 84. *Puccinia mucronata* var. *rosæ*, Pers., Syn. Fungi, page 230. *Puccinia rosæ*, D. C., Flor. Franc., vol. 2, page 218. *Uredo rosæ*, Pers., Dispos., page 13. *Uredo miniata*, Pers., Syn., page 216. *Uredo elevata*, Schum., Enum. Plant. Saell., II, page 229. *Uredo pinguis*, D. C., Flor. Franc., II, page 225.

‡It appears to us that the name given this fungus by Link, *Phragmidium mucronatum*, is the one which ought to be adopted, it being the earliest name applied to this species in the genus *Phragmidium*. It is certainly straining a point, needlessly multiplying synonyms, and confusing the citations of authors, to revive a part of an older name after the fungus has already been published under *Phragmidium*, merely for the sake of paying tribute (doubtful in some cases, at least) to him who first describes the fungus, or one stage in its development.

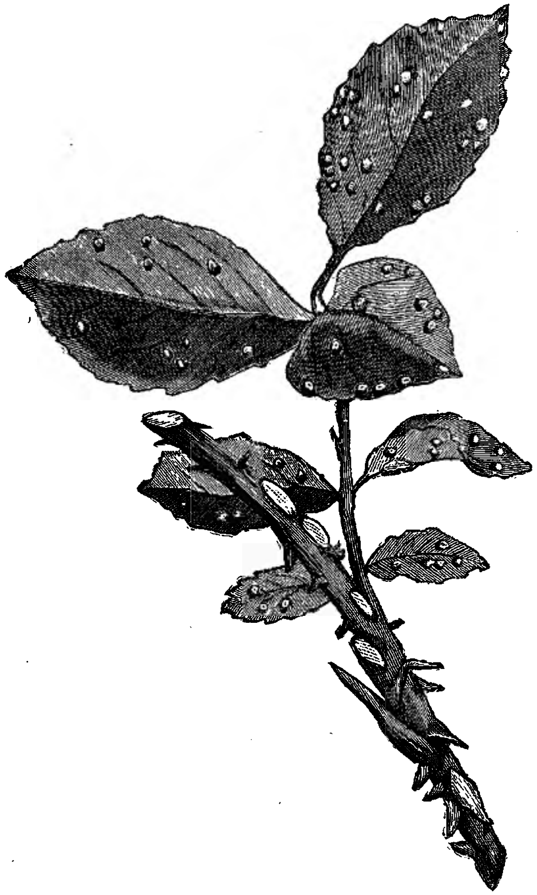


Figure 105.

spots, which increase in size as the season advances. On the leaves the spots are scattered irregularly over both surfaces, being lighter in color above than below. These spots mark the points of development of the fungus, and as this development progresses within the tissues the parasite finally breaks through the epidermis on the under surface of the leaves forming little granular pustules. The larger pustules appear on the principal vines, along which they may extend for a considerable distance. When the nerves are thus attacked the leaves become twisted and misshapen.

The spots on the leaf stalks and shoots are usually larger than those on the leaves. They are elongated in the direction of growth (one half inch sometimes), and are surrounded by the broken edges of the ruptured cuticle. The action of the parasite often incites an excessive cell development in the tissues of the host, in consequence of which the shoots are found more or less bent away from the point of attack.

If we examine the rose leaves closely about mid-summer we will find that the orange-yellow spots have been replaced (to all appearances) by spots of a brick-red color, and later in the season another and more marked change occurs; the under surfaces of the diseased leaves then are seen to be more or less thickly sprinkled with minute, black, hair-like tufts. Frequently the brick-red stage and the one last mentioned are found together, and sometimes all three forms may be seen on the same leaf.

Botanical Characters.

A microscopical examination of the early or orange stage of the disease will show us that the pustules are made up of an immense number of globose or angular bodies arranged in compact vertical rows or chains. The formation of these bodies begins at a point some distance beneath the cuticle, and it is by their growth that the latter is finally ruptured. This period of development is known as the æcidio stage of the parasite, and the angular or rounded bodies referred to are the æcidiospores. These have an average diameter of from 18 μ to 22 μ (1 $\mu = \frac{1}{2500}$ inch), and, like the seeds of higher plants, they serve to spread and propagate the fungus. With these spores, usually surrounding each group or pustule, are peculiar club-shaped growths termed paraphyses.

In the second or uredo-stage the spores are similar in shape and size to the æcidiospores, but they have their outer surface finely roughened and they are grouped differently.

Surrounding each collection of these spores the same club-shaped bodies observed in the æcidio-stage occur. These are sterile organs of doubtful functions, which accompany the spores of many fungi. In the present instance they have obtuse club-shaped tips and are somewhat incurved and form a sort of cup around the spore masses.*

The spores in this second or uredo-stage are borne on short pedicles, and otherwise differ from the æcidiospores in having their outer surface roughened.

The spores in the third or last stage are very markedly different from those preceding. They are very dark colored, roughened, cylindrical bodies, about 25 μ in diameter and 60 μ to 75 μ long, divided by septa into from five to eleven cells and abruptly terminated by a short, colorless point. The stalks supporting them are comparatively short, colorless, and considerably enlarged or swollen towards the base. The same colorless paraphyses accompany this stage, as were seen in the two preceding.

The æcidio and uredospores germinate readily under favorable conditions, as soon as they reach maturity; but when kept dry for a few weeks they lose this power of germination. The last spores formed, however, the teleutospores, as they are called, retain their vitality for a long time and can rarely be germinated by artificial cultures until the spring following the season of their development. In the process of germination the spores of the first and second stages send out slender germ tubes which, if properly placed, penetrate the tissues of the plants attacked. These spores are evidently designed for the immediate and rapid propagation of the fungus during the growing season, while the teleutospores preserve the life of the parasite during the winter and only germinate in the spring, ultimately giving rise to the various forms we have described.

The teleutospores germinate by sending out somewhat thickened tubes (usually one tube issues from each cell) which, after attaining a length several times that of the spore, produce several minute globose bodies on short and slender stalks. These bodies, named sporidia, are easily wafted from place to place by the slightest currents of air, and when they fall upon

---

*The uredo-stage of this fungus has received several names by the older mycologists, among them *Uredo miniata*, Pers., and *Colæosporium miniatum*, Lev.

rose leaves where there is moisture they send out slender filaments which probably bore their way through the cuticle into the interior of the leaf, and a new fungus growth takes place.

Treatment.

Understanding the character and manner of development of the rose rust enables us to suggest several methods of combating it. In the first place, the plants should be carefully watched, and at the first appearance of the disease the affected branches should be removed and destroyed. If the disease reappears upon the new growth it would be best to dig out the plants and destroy them, as it is better to sacrifice a few plants at the beginning than have them breed infection to all others which may be near.

Never wait until the spots show the granular pustules before destroying the affected parts, but remove the shoots upon the first indication of the yellow spots. Where the disease has prevailed it would be well to rake all the old and fallen leaves together in the autumn and burn them, for by this means millions of the taleutospores will be destroyed.

It is probable that some benefit may result from the use of solutions containing sulphate of copper, as this substance is known to prevent the spores of many fungi from germinating, even when present on the parts subject to attack in very small quantities.

In localities where the disease has prevailed in previous years a preventive treatment may be made by applying to the plants in early spring, a solution of sulphate of copper and carbonate of soda, prepared as directed. This should be applied to the leaves and young branches with an atomizer, thoroughly wetting all the parts, but not drenching them with the fluid. After drying this preparation is strongly adherent, and its presence even in very minute quantities is sufficient to prevent the spores of the fungus from germinating. It is obvious that if the germination of the spores is prevented infection cannot take place. A very dilute solution of chloride of iron, which is reported to have proved efficacious in the treatment of the coffee disease (*Hemileia vastatrix*), may also be tried as a preventive.

ROSE-LEAF BLACK SPOT.

Actinonema rosæ.

There are several parasitic fungi that produce black spots upon the leaves of our cultivated roses; but the most common and injurious, and the one to which we generally refer in speaking of the "leaf spot," is that known to mycologists as *Actinonema rosæ.* It was named *Asteroma rosæ* by Libert as early as 1826, and afterwards transferred to the genus *Actinonema* by Fries. It is also called *Asteroma radiosum.* The nature of the disease has been studied and described by Frank and Eriksson, and Sorauer describes it in detail in the second edition of his work on "Diseases of Plants."

The disease is very widespread, occurring in nearly all the countries of Europe as well as in the United States. Here it is quite universal, although there are local areas apparently free from it.

External Characters.

Late in the spring, or early in the summer, the disease makes its appearance in the form of round or irregularly-shaped black spots upon the upper

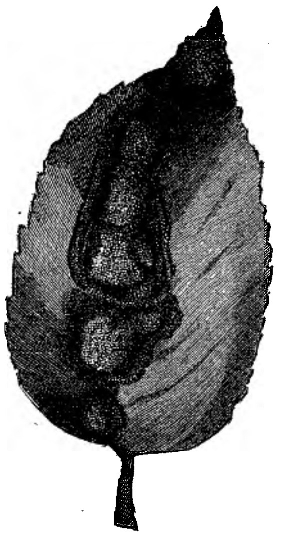


Figure 106.

surface of the living leaves. Generally only the full-grown leaves are attacked, and those within three or four inches of the branches seem to be healthy. The spots are small at first, but as the disease progresses they increase in size, and may become half an inch in diameter. Often a number of them coalesce, and in severe attacks the leaf is nearly covered with large dark patches. From the beginning the spots are fringed at the edges, and although the form is frequently irregular at first, they usually become distinctly circular later, especially on the smooth-leaved varieties. In the latter part of the season the spots grow light colored and dry in the center, showing that that part of the leaf is entirely dead, and by this time, if not before, the discoloration penetrates through the leaf and appears on its under side.

The moss roses and those with thick, rough leaves seem to suffer more than other kinds, but there are few, if any, that are invulnerable to the parasite. Those which escape early in the season are apt to succumb before fall, if the other roses in the vicinity are diseased.

The effect of the disease upon the leaf is soon apparent by its turning yellow in places, and sometimes by a yellow band outside the black spot. When cold weather approaches, the leaves that are diseased are the first to turn yellow. During the autumn the yellow color is apt to appear at the apex of the leaflets, whence it spreads downward and is succeeded by brown. A leaf with a green base and brown tip, with a yellow band between, is very characteristic of this disease. Premature fall of the leaves is another effect of this parasite. Diseased leaves may fall before they turn yellow, and plants attacked by the fungus generally have a partly defoliated appearance.

It is evident that we have here a case in which the effect of the fungus is not confined to the area it actually occupies. Its growth does not extend over all those parts of the leaf which turn yellow, nor can any mycelium be found at the base of the petiole when the leaf falls before its time. It seems that the interference with assimilation which must result over the diseased areas, so affects the entire leaf as to destroy its vitality. If the autumn is long and pleasant, the plant is apt to exhaust itself by putting out new leaves, which are destroyed by frost before they can be of any service.

The fungus is very hardy, and does not depend to any great extent upon climatic conditions for its development; but, like other diseases of this kind, it proves most troublesome in a moist and warm environment.

Roses kept under cover are better protected from infection, and are consequently more free from the disease. This explains why tea roses and others that are kept in greenhouses over winter are not so badly affected as those in open grounds. The truth is, probably, that the disease has a long period of incubation before it is visible, and before this period is over for roses that have been potted, the season is far advanced, and they do not have time to get badly diseased before they are potted again.

Botanical Characters.

The parasite, as it is known on the rose, is probably but one stage in the life history of the fungus. From its analogies it is classed with the sphæriaceous fungi, although, so far as recorded, no perithecia have been observed in this species. But in other species similar in habit to this one, perithecia-like forms, more accurately known as pycnidia, occur.

Mycelium.—The mycelium is composed of two distinct parts, one situated between the cuticle and epidermis, and the other penetrating the leaf tissues. The former is apparently superficial, as it shows through the transparent cuticle. It is composed of branched septate hyphæ that radiate from a center and lie side by side in strands of from one to eight. When a hypha branches it may run along parallel to the main thread or may bend off at an acute angle and form an independent strand. Other mycelial filaments branch off from the under surface of this superficial layer and penetrate the leaf tissues, first entering the epidermal cells, and sometimes nearly filling them with convolutions. From these it pushes between the palisade cells, and finally appears in the loose parenchyma. Below the epidermal cells it is rarely visible, since it is so transparent that it is easily concealed by the cell contents; but when the cells are dead and shrunken, it can be seen between them. It penetrates the tissues very slowly, and reaches the loose parenchyma only in the last stages of the disease. This second portion of the mycelium absorbs nourishment for the entire fungus.

Spores.—The spores are borne upon the superficial layer. Short vertical branches may arise upon any of the strands; these branches force the cuticle apart from the epidermis and soon form colorless two-celled spores upon very short basidia. When the spores are nearly full grown the pressure upon the cuticle becomes great enough to rupture it irregularly, allowing the spores to escape. The mature spore is deeply constricted at the union of the two cells. The cells are oblong, nearly twice as long as broad, sometimes larger at the ends than in the center, and contain two nuclei. Sometimes the two cells fall apart, and before they become free from their basidia the lower one frequently has the appearance of a pedicel.

The effect of the parasite upon the leaf tissues is at first apparent in the shape of a dark yellow mass, evidently composed of the transformed cell contents that collect in the upper part of the epidermal cells. The upper row of palisade cells next become discolored, and the chlorophyll bodies disorganized, and this process slowly extends through the leaf. It is this discoloration of the cell contents that gives the dark color to the spot. In some species of *Actinonema* the mycelium itself is dark colored; but on the

rose it has little or no color, and the fringed appearance of the spots is due to the fact that a few discolored cells follow the mycelium where single strands project beyond the others. Just underneath the fruiting spots the mycelium seems to have some color, and these spots look blacker than the surrounding surface.

Treatment.

Owing to the hardy nature of the fungus, and to the fact that the mycelium develops within the leaf tissues, the disease is very difficult to deal with. Although the fungus does not live over winter in the woody portions of the plant, the disease, having once entered a garden, is sure to reappear for successive seasons, for the spores are lodged upon the buds at the base of the petioles by water trickling down the leaf stalk, and the shoot springing from these the following season is necessarily tainted. For the same reason, cuttings from diseased bushes will spread the fungus. Unless some plan can be adopted by which the spores can be destroyed early in the season, before they have germinated and produced a mycelium within the leaves, a garden once infested by the parasite is beyond recovery, and a new site must be selected, in which no roses must be planted that are not perfectly healthy.

It is probable, however, that we may succeed in saving roses once attacked. For this purpose all the leaves should be carefully burned in the fall, and the bushes and ground carefully sprayed with some fungicide before the buds start in the spring. Much may also be done by picking and burning every leaf as soon as it shows the faintest trace of disease.

A solution of copper sulphate may be used for spraying the bushes, but should not be used upon the leaves, as it will be apt to burn the foliage. After the leaves have started, applications of Bordeaux mixture or Eau celeste, modified by the addition of carbonate of soda, will be beneficial in preventing the spread of the disease. This treatment should be repeated three or four times during the season, so as to protect succeeding growths of leaves.

STRAWBERRY-LEAF BLIGHT.

Sphærella fragariæ.

There are a dozen or more fungi which infest the strawberry plant, but the best known, and doubtless the one more injurious than all the others combined, is that which causes the disease we have here named "Strawberry-leaf Blight." It has been called the "spot disease of strawberry leaves,"* "sunburn," and often "strawberry rust."†

This disease is due to the attacks of a parasitic fungus which is common both in this country and in Europe. Here we have observed it from Maine in the East to California in the West, and complaints of its ravages have come to us from Florida and other sections of the South. It does not limit its attacks to the cultivated varieties, for we have frequently observed it on wild plants, and even on the common Cinquefoil, a plant botanically related to the strawberry.

The strawberry-leaf blight fungus was first studied with the view of tracing its life history by two French mycologists, the Tulasne brothers,

---

*Trelease, 2d Ann. Rept. Wis. Exper. St., 1885.

†We have attempted to restrict the term "rust" to those diseases caused by species of the family *Uredineæ*, and "spot" diseases to such as result from the attacks of parasites included in the genus *Phyllosticta*, etc., adopting the term "blight" for those caused by species of *Ramularia*, *Cercospora*, etc.

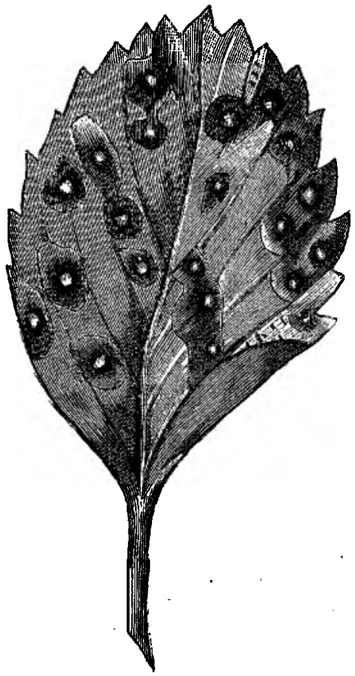


Figure 107.

some twenty years ago. They figured and described the forms, determined by them under the name of *Stigmatea fragariæ*, and by this name the fungus was known in Europe until 1882, when it was transferred to the genus *Sphærella* by Saccardo.* The same author described the summer stage of the fungus in 1879 as *Ramularia tulasnei*, and in 1883 the same form was published by Mr. Charles H. Peck under the name of *Ramularia fragariæ*. This stage of the fungus has been made the subject of papers by several American botanists, but none have attempted to trace the development of the other forms in its life history.

External Characters of the Blight.

Very small, deep purple or red spots appearing on the upper surface of the leaves are the first symptoms of this disease. These spots rapidly increase in size, and at the same time their color changes from purple to reddish brown; eventually they become gray or white in the center, so that they finally present a gray or white central area surrounded by a dark purple border shading off towards the healthy tissues to reddish brown. The spots vary in diameter from one sixth to nearly one fourth of an inch, but it very frequently happens that several contiguous spots coalesce and form large, irregular-shaped blotches. The bright color which these spots impart to the leaves renders the latter particularly conspicuous, and this appearance is familiar to every strawberry grower. The leaves badly affected soon turn brown, this discoloration usually beginning at their tips, and become shriveled and finally die. Similar spots to those above described sometimes appear on the calyx and on the stems supporting the young berries or fruit.

---

* Syllog. Fung., I, 505.

Effects and Losses.

The effect of the strawberry-leaf blight on the foliage of the plants, even in mild cases, must be detrimental to the processes of assimilation; and when the attack is severe it results in the early destruction and death of the plants. If the fruiting stems or leaves of the calyx are attacked the young berries never reach maturity, or the fruit becomes shriveled and unfit for use.

The injury to strawberry culture resulting from this disease appears to have been on the increase during the past five or six years, to the general alarm of the growers of this fruit. No special efforts have been taken to learn the actual extent to which this fruit industry has suffered from the ravages of the blight, but enough has been learned to demonstrate its gravity. In some localities the injury effected has been comparatively slight, while in others entire plantations have been completely destroyed. It appears that the disease is most severe in the States of Illinois, Michigan, Wisconsin, Minnesota, Iowa, Missouri, Kansas, and Kentucky. In southern Illinois, where there are more strawberries grown than in any other section of the country, the blight is deemed one of the worst enemies with which the cultivator of this fruit has to contend, and the losses sustained are often very great. A Connecticut correspondent states that in one year he lost $1,500 on a field of six acres from the strawberry blight. In Louisiana and other Southern States the disease is less destructive. This is probably due to the fact that in this section the plants are renewed every year, allowing no opportunity for the fungus to gain a foothold.

The attacks may occur at any time during the growing season under the proper weather conditions. Those coming early, if severe, injure the immediate crop, while later attacks may entirely destroy the prospects of a crop the year following. It is the opinion of some strawberry growers that the heavier the crop the more likely are the plants to be attacked by blight after the fruit is gathered. The death of the plants before the close of the season sometimes results from these late attacks.

Some varieties appear to be more subject to the disease than others, but we are unable, at this time, to make any classification based on their degree of susceptibility. The following varieties have been mentioned* as among those most subject to the disease: Downing, Wilson, Russel's Prolific, Big Bob, Bidwell, Captain Jack, Forest Rose, and Manchester; those notably free are Crescent, Windsor Chief, and Sharpless.

Conditions Favoring the Development of Strawberry-Leaf Blight.

Heat and moisture favor the development of strawberry blight, and at any time during the summer when the weather is hot and moist the plants are likely to be attacked. Heavy dews or rains are essential to infection, but the disease may continue its work of destruction during dry weather; and it not infrequently happens that it develops in its worst form in dry, hot weather succeeding a period of frequent or heavy rains. The fungus causing the malady is truly parasitic in its habits, and, except that the conditions which may favor its development be inimical to the plants, the health or vitality of the latter does not enter into consideration. Other things being equal, plants, however vigorous and well cared for, are no less subject to the blight than those in feeble health.

In respect to the soil the disease is undoubtedly most severe when the land is heavy or wet and undrained. We have in mind an instance which will illustrate this point. A plantation of about five acres was bordered on one side by a brook, towards which the land gradually sloped. For about sixty feet back from the brook the soil was marshy and wet, while the remainder of the field was fairly well drained. The plants on the narrow strip of wet land were much more severely diseased with blight than those on the comparatively dry soil adjoining. The effect was like that sometimes observed when two varieties—the one resistant and the other susceptible to the disease—grow side by side. In the present instance there were a number of varieties planted in rows running at right angles to the brook, so that the greater severity of the disease on the wet land could not be attributed to any difference in susceptibility of varieties. The disease in the locality here noted appeared early in May, some ten days after a heavy rainfall which was succeeded by damp, cloudy weather.

---

* Second Annual Report Wisc. Agr. Exp. Station, p. 48.

A deep and thoroughly well drained soil will supply sufficient moisture to keep the strawberry plants in good condition, but not enough to favor excessive development of the blight.

Botanical Characters.

The fungus causing the strawberry-leaf blight, although of microscopic size, is a plant like the strawberry itself, and consists of a vegetative and reproductive system; the former is the mycelium or plant body of the parasite; the latter comprises the spores or reproductive bodies and the organs supporting or containing them.

The Mycelium.—The vegetative part of the fungus is made up of slender, thread-like tubes, which grow between and sometimes into the cells of the host. These threads are colorless (sometimes tinted brown), flexuous, often anastosmosing, septate, and varying in diameter from 1.5 μ to 3 μ ($1\ \mu = \frac{1}{25000}$ of an inch). It is through the action of these mycelial threads on the cell contents of the host that the external characters of the disease, already noted, are produced.

Reproductive System.—The reproductive system of *Sphærella fragariæ* is quite complex, and although it has been studied very carefully it is not yet fully understood. From our examinations of the material at our disposal we have been able to determine three spore forms, and possibly a fourth; the three of which we feel sure are conidia, spermatia, and ascospores. We are yet doubtful in regard to the pycnidia.

Conidia.—The best known, and doubtless the most important reproductive bodies, economically considered, are the conidia. After the mycelium has grown for a time within the leaves, and the light-colored central areas of the spots appear, the threads occupying this portion become massed together at frequent points just beneath the cuticle of either surface, and from these masses numerous short, colorless branches are sent out either through the stomata or ruptured cuticle, and it is upon their free ends that the earlier development of conidia takes place. The length of the branches varies a good deal, but usually ranges between 30 μ and 50 μ; they are sometimes composed of a simple elongated cell, but often they are divided by transverse septa into two to several cells. At a later period in the development of the fungus, conidia-bearing branches may arise from the perithecia, described below.

On the free ends of the branches the young conidia are developed, first as minute globose bodies, but, rapidly elongating, they soon appear. Sometimes a succession of spores, held together in a single series or chain by their contiguous ends, are formed upon a single stalk, and sometimes, though very rarely, two such series are developed from the apex of a common support. The free apex of the terminal conidium, whether it stands alone or forms one of a series, is obtuse and rounded; the other end and the extremities of those standing intermediate in a series are flattened at the point of attachment. Their length is from 20 μ to 50 μ, and they have a diameter of from 2.5 μ to 4 μ. Often only one-celled, they are frequently divided by transverse septa into two or three cells. They are colorless, like the stalks which support them, and are filled with a transparent, slightly granular fluid. The formation of these conidia continues throughout the summer, under favoring conditions of moisture and heat, and as they are exceedingly light and germinate readily in water, the rapid spread of the fungus and consequent disease over a plantation or section of country is easily understood. This stage of the fungus has been named *Ramularia fragariæ* by Charles H. Peck, and *Ramularia tulasnei* by Saccardo.

At the approach of cold weather the formation of the conidia ceases, but the mycelium of the fungus remains alive in the tissues of the leaves, and in early spring a few warm days are sufficient to bring forth a new crop ready to spread infection at the first opportunity.

When the conidia are sown in water at a temperature of about 60 degrees Fahrenheit, they will in a few hours send out slender germ tubes, which increase rapidly in length by continued apical growth. In forty-eight hours the germ tubes attain a length of many times that of the conidium from which they start, and are usually several times branched. Water is necessary to effect germination.

If, after a prolonged rain, a drop of water from a diseased leaf, or from an apparently healthy one growing close by, is examined with a good microscope, large numbers of conidia in various stages of germination will usually be seen. It is during such periods that the healthy leaves are infected; the germ tubes enter the leaf (either by directly penetrating the cuticle or through the "breathing pores"), and once within the tissue they may continue to grow independent of external circumstances.

Conidia sown on healthy leaves of pot-grown strawberry plants, which for three days following were kept constantly wet, produced the characteristic purple spots in about eighteen days. Similar sowings on leaves kept constantly dry were not infected, although the plants in both cases were cared for alike, except in the matter of moisture.

Repeated sowings of the conidia in solutions employed as fungicides were made. None germinated in a 1 per cent solution of hyposulphite of soda, or in a one fourth of 1 per cent solution of sulphate of copper. A very small quantity of lime in water used in these experiments also checked the germination of the conidia.

Spermogonia.—During the autumn and early winter there is developed on the mycelium numerous round or ovoid bodies, which, as they increase in size, break through the tissues of the leaf, appearing on the surface as minute black specks. Some of these bodies are the spermogonia, their interior being filled with spermatia. The spermatia have a length of 3 μ, and are about three times as long as broad. They are produced in vast numbers, and doubtless serve some important office in the economy of the fungus, but just what that office is has never been clearly demonstrated.*

---

*A fungus named *Septoria aciculosa*, often found associated with *Sphærella fragariæ*, has been thought by some to be the spermogonia of the latter, but its spores are often two-celled, and they germinate without difficulty, contrary to the character of the spermatia. Possibly it represents the pycnidial stage of the *Sphærella*, but this is very doubtful. *Septoria fragariæ* has also been thought by some to be the spermogonial stage of the *Sphærella*, but there is no longer any reason for supposing this to be the case. Another fungus (*Ascochyta fragariæ*), sometimes found associated with the *Sphærella*, has been regarded as its pycnidial form, but from our observations we can see no reason for accepting this view, although we have occasionally found this fungus on leaves destroyed by blight.

Perithecia.—By far the larger number of the black bodies above mentioned are perithecia. They are last to come to maturity; at the time the spermatia are most abundant their interior is filled with a clear mass of cells. They are usually somewhat larger (90 μ to 130 μ in diameter) than the spermogonia, and their outer walls are more nearly black and apparently thicker or firmer in texture. They are usually partially imbedded in the ruptured leaf surface, but not infrequently they appear to be resting directly upon it. At the top of each there is a small opening or ostiolum which permits the contents to escape at maturity. If the perithecia be examined during the latter part of winter or early spring (they are almost always found abundantly on leaves destroyed by blight the previous year), the interior will be seen to be filled with numerous transparent sacs or asci attached to a thin layer of light-colored tissue resting on the bottom wall. These sacs are abont 50 μ long and about 10 μ in diameter above, tapering below to a narrow base. Within them are formed the ascospores, usually eight in number in each sac, which are true reproductive bodies, designed, no doubt, to preserve the life of the fungus in special cases, but, as we have already seen, they are not essential to its perpetuation from one year to another. They are narrowly ovoid in shape, being more pointed below, and are divided into two cells by a transverse septum near the middle.*

Conidia-bearing stalks similar to those we have already described, often grow in great numbers from the outer wall of the perithecium around the ostiolum, and like developments have been observed by us arising from similar parts of the spermogonia. These stalks produce conidia in every way like those which are formed in the early stages of the disease. By placing the old diseased leaves, upon which there are perithecia, in a moist atmosphere under a tumbler or bell jar, the conidia-bearing stalks and conidia will grow from the latter in the greatest profusion.

From our studies of this fungus we conclude that its life history is limited to the developments above described: First, there is the mycelium, which endures throughout the year; second, the conidia, produced in summer on short stalks arising from cushion-like masses of mycelium formed just beneath the cuticle. This stage appears to us to correspond to the pycnidial stage of the fungus of the black-rot of grapes, only, in this instance, the pycnidial walls are not developed, consequently the basidia and their spores are exposed; third, the spermogonia, which appear late in the season; and, fourth, the perithecia, with their asci and ascospores, found in early spring on leaves destroyed by the blight the previous year. The spore-forms are the summer conidia, the conidia which are produced on stalks that grow from the tops of the spermogonia and perithecia, the spermatia, and the ascospores.

The conidia are designed for the rapid propagation of the fungus, as shown by their great abundance and the ease with which they germinate. The ascospores, securely protected by the walls of the perithecium, are doubtless designed to perpetuate the fungus under conditions fatal to the life of the conidia.

Treatment.

A knowledge of the habits of the fungus of strawberry-leaf blight shows us that the treatment of the disease must be preventive. The fungus, when once inside the leaf, can only be destroyed at the expense of the latter.

We can mitigate the evil, and oftentimes wholly avoid it, by pursuing special systems of culture. By annually renewing the settings and planting only in deep and thoroughly well drained soil, loss from blight will seldom occur. Some have escaped the ravages of the disease by removing all the old leaves immediately after the fruit is harvested and cultivating the ground, at the same time adding some quick fertilizer. The easiest way to remove the leaves is to mow the beds, then rake the leaves together and burn them.

A simpler line of treatment, and one more likely to secure the desired result, is the application to the plants of some fungicide which will destroy or prevent the germination of the conidia falling upon the leaves. We have seen from our laboratory experiments that these conidia will not germinate in very dilute solutions of hyposulphite of soda or sulphate of copper. It is a simple matter to apply similar solutions to the plants in the field, where it is only reasonable to suppose they will have a like action on the reproductive bodies in question.

Prepare the solution of hyposulphite of soda by dissolving one pound of the hyposulphite in ten gallons of water. Apply with a convenient force pump having a spraying nozzle of fine aperture.

The action of this remedy is immediate, hence it is necessary to apply it frequently during the season.

The sulphate of copper solution with carbonate of soda, or the following solution of ammonia calcarbonate of copper, may be useful in treating this disease: In one quart of liquid ammonia dissolve three ounces of carbonate of copper, then dilute to twenty gallons.

These preparations of copper salts should be applied in the same manner as the hyposulphite of soda solution. They adhere very strongly to the foliage, and as the copper they contain dissolves very slowly their preventive action against the fungus lasts for a long time.

A solution of sulphide of potassium or "liver of sulphur" has been employed in combating the blight of the strawberry with encouraging results. Mr. R. E. Buffum, of the University of Virginia, writes:

> I sprinkled the strawberry plants with a solution made by dissolving one ounce of sulphide potassium in eight gallons of water, repeating the operation several times before the berries ripened. This, I think, had a beneficial effect, as there was certainly a marked decrease in the amount of blight.

Prof. J. C. Arthur states in the Sixth Annual Report of the New York Agricultural Experiment Station, page 351, that—

> A part of a bed of Sharpless strawberries was sprayed four times with a solution of sulphide of potassium (one half ounce to one gallon of water) with the object of holding in check the spotting of the leaves, due to the fungus *Ramularia tulasnei*, often described as "sun-burn." The object sought was attained, as that part of the bed took on a more vigorous growth and showed fewer spotted leaves than the remainder. In fact, the difference between the sprayed and unsprayed portions was so marked that it seems unsafe to ascribe it wholly to the fungicide, it being better to content one's self with the strong indication that the sulphide is likely to prove a serviceable preventive of this disease, and to leave the question of its full efficiency to be determined by future trials.

As the value of whatever remedy may be employed depends entirely upon its power to *prevent* the germination of the conidia of the fungus, the necessity of making the applications early is obvious.

---

* These ascospores are more elongated and rather more pointed at the narrow end than those figured by Tulasne, but they are certainly of the same species.

XXIX.

BENEFICIAL INSECTS.

The beneficial insects herein described are among those best known in this State, and may be classed as the best friends of the fruit grower, as by their united efforts they assist most materially in the work of destroying injurious insects, the natural fecundity of which is so great that they could not otherwise be effectually destroyed.

INTRODUCTION OF PARASITES AND BENEFICIAL INSECTS.

The idea of importing parasites and beneficial insects into this State was first conceived by this Board.* As early as 1881, when this Board was first established, the propagation and importation of beneficial insects was considered, an account of which may be seen in the first report of the Board for 1881, to which reference has often been made by our President before the various conventions of fruit growers held throughout the State.

From time to time we have memorialized Congress for the passage of a bill to enable the United States Department of Agriculture to send an expert to foreign countries, to search for and import into this State, the parasites and beneficial insects there found, for distribution among our orchardists, a brief resumé of these memorials being here given:

At our meeting held at Riverside, San Bernardino County, April 12, 1887, the following resolution was adopted:

> *Resolved*, That a memorial to Congress be prepared, setting forth the needs of this coast in the matter of exterminating insect pests, and asking that an adequate appropriation be made to be used by the Division of Entomology in the Agricultural Department of the United States, in the investigation of the parasites and predaceous insects of the cottony cushion scale, and all other injurious scale insects in their native country, Australia, and their introduction into this country.

The above resolution was formulated into a petition and was transmitted to the United States Senate and House of Representatives, copies being mailed to each Senator and Representative.

In accordance with our wishes as expressed in said resolution, Hon. C. N. Felton, of San Mateo, introduced a resolution authorizing the Commissioner of Agriculture to at once delegate an agent to visit Australia, New Zealand, and other countries, in search of parasites, if any were found preying on the scale insects there. This resolution, however, failed to pass.

At our meeting held at Santa Rosa, November 11, 1887, we adopted the following resolutions:

> *Resolved*, That the Government of the United States he requested to appropriate an adequate sum of money to be used by the Division of Entomology of the United States for the following purposes:
>
> First—To send an Entomologist to Australia, New Zealand, and adjacent islands, the native countries of the cottony cushion scale (*Icerya purchasi*), and of the red orange scale (*Aspidiotus aurantii*), to search for and study the habits of parasites and predaceous enemies of the said insects.

> Second—To collect and import into the United States, propagate, and distribute to infected districts such natural enemies of the above named scale bugs, or of other noxious insects, as it may seem best to import, with a view to the relief of our horticulturists.
>
> *Resolved*, That we request the Secretary of the State Board of Horticulture to prepare a brief statement as to the importation of the above mentioned scale bugs into the United States, ravages already committed by them, and what is to be feared from them in the future if not checked, and to furnish Senator Hearst with copies of the same for distribution.

In accordance with said resolution, I prepared a brief statement as to the importance of introducing the parasites named, together with a brief statement of the ravages committed by the scale insects which were originally introduced on trees imported from Australia into California.

The resolutions were also formulated into a petition and forwarded to the United States Senate and House of Representatives, together with the statement of the ravages committed by scale insects in our State.

At our meeting held at Santa Barbara, April 10, 1888, we passed the following resolution:

> WHEREAS, There are $20,000,000 invested in fruit culture in this State; and, whereas, this may indefinitely increase if given the proper conditions; and, whereas, the cottony cushion scale (*Icerya purchasi*) threatens the very existence of the citrus industry in this State, as well as numbers of the other fruit trees; and, whereas, it stands to reason, that there are parasites for these different scale bugs, in the places of their nativity; therefore, be it
>
> *Resolved, by the fruit growers of California in Convention assembled*, That the United States Congress be petitioned for an appropriation of not less than $50,000, to be used by the Department of Agriculture, for the purpose of sending experts to those countries where the baneful insects are known to have originated; to discover, if possible, their natural enemies, the parasites, and introduce them into this country; also, that the Department of Agriculture be enabled to make actual experiments here in the field to, if possible, overcome these injurious insects.

This resolution, like the others, was formulated in the form of a petition, and forwarded to the United States Senate and House of Representatives.

Our Congressmen tried in vain to secure the passage of a bill appointing a Commission to go to Australia, New Zealand, and other countries, in search of parasites. Fortunately for us Congress had appropriated a large sum of money to enable our people to make an exhibition during the Exposition at Melbourne, in 1888, and by happy chance, the Hon. G. L. Rives, Assistant Secretary of State (United States), and the Chief of the Commission, the Hon. Frank McCoppin, of San Francisco, at the suggestion of the Hon. J. DeBarth Shorb, of San Gabriel, were kind enough to set aside a sufficient sum to defray the expenses of two agents, as the following official correspondence shows:

DEPARTMENT OF STATE,
WASHINGTON, June 22, 1888.

N. J. COLMAN, *Esq., Commissioner of Agriculture:*

SIR: I have just received from Mr. McCoppin, Commissioner of the United States to the Melbourne Exhibition, a letter, from which I quote the following: "Lieutenant Marix has handed me a memorandum from Mr. C. V. Riley, U. S. Entomologist, with reference to an insect brought hither from Australia, which is very destructive of the fruit and shade trees in Southern California. My attention had already been called to this subject by Mr. DeBarth Shorb, of Los Angeles, who thinks it is of the first importance that the enemies of this pest should be introduced into this State. Therefore, notwithstanding the limited means at my [your] disposal for all these purposes, I am in favor of having Mr. Riley and his assistants sent to Australia at the expense of the Commission ($2,000), provided he will come as an aid to the Commission, to the end that his report shall be made a part of the final report of the Commissioner to the Secretary of State."

I am, sir, your obedient servant,

G. L. RIVES,
Assistant Secretary.

---

* Although public attention was first called to it by Mr. Alexander Craw, of Los Angeles.

U. S. DEPARTMENT OF AGRICULTURE, COMMISSIONER'S OFFICE,
WASHINGTON, D. C., June 23, 1888.

G. L. RIVES, *Esq.*, *Assistant Secretary of State:*

SIR: I have your favor of the twenty-second instant, informing me of the receipt by you of a letter by Mr. McCoppin, Commissioner of the United States to the Melbourne Exposition, and giving me the contents thereof. There can be no question as to the importance of the investigation alluded to, and I know of nothing to prevent my complying, with the proviso that the party or parties I may send to do this work will go as an aid or as aids to the Commission, and make a report which shall be part of the general report to the Secretary of State. I will, therefore, take steps at once to carry out the investigation, and I take it that the accounts should all be made to the State Department, as of other members of the Commission, and that the report is to be transmitted by me through the President of the Commission. Please inform me if I am right in these conclusions.

I have the honor to remain yours respectfully,

NORMAN J. COLMAN,
Commissioner.

DEPARTMENT OF STATE,
WASHINGTON, June 26, 1888.

NORMAN J. COLMAN, *Esq.*, *Commissioner of Agriculture:*

SIR: I have to acknowledge the receipt of your letter of the twenty-third instant, in which you state that you will at once take steps to send one or more persons as assistants to Mr. McCoppin, Commissioner of the United States to the Melbourne Exhibition, and you ask whether the accounts of the persons so sent should be made to the Department of State, and whether their report should be transmitted by you through the Chief Commissioner.

In reply, I have to inform you that the matter of employing and compensating subordinate assistants has been left entirely to the discretion of Mr. McCoppin, subject, of course, to the eventual control of the Secretary of State. In the present instance, the Department approves of Mr. McCoppin's arrangement, but the details of the accounts of the persons you may designate to be associated with him should be submitted to Mr. McCoppin, who has ample funds to pay them. The reports in regard to the matters with which these persons may be specially familiar, should be also submitted to Mr. McCoppin direct, by whom they will be transmitted to this Department with his final report.

In brief, the gentlemen whom you propose to send, so far as they represent the United States in any capacity at the Melbourne Exhibition, will be entirely under the direction and control of Mr. McCoppin, who will audit and pay their accounts, and to whom they will report.

I am, sir, your obedient servant,

G. L. RIVES,
Assistant Secretary.

Accordingly Mr. Albert Keobele, of Alameda, received full instructions, and sailed on the steamer of August 20, 1888, for Australia. After Mr. Keobele's arrival there he discovered several beneficial insects preying on the cottony cushion scale, and forwarded to this State several internal parasites, which, however, did not increase sufficiently fast enough to keep the scale insects in check. After the receipt of several shipments, the little Vedalia arrived and was placed on trees in Los Angeles under cover, so that they should not escape until their merits were fully known. Very soon thereafter they began destroying the scale insects with such rapidity that all eyes turned to this *most* wonderful predaceous beetle. From these trees, under cover of cheese cloth, it was evident that many had made their escape, as they were found on other trees and adjacent orchards. The trees being covered it was almost impossible for the beetles to escape, but the young larva, as it crawled about, would pass through openings between threads in the cloth, and would pupate on the outside, and then emerge into a beetle. So fast did they propagate that in a very short time many more of the insects could be found on the outside than on the trees upon which it had been intended to keep them confined. In April last the grounds of Mr. J. W. Wolfskill, in Los Angeles, upon whose trees they had been colonized, were visited. It was astonishing how quick they were in their movements, and with what rapidity they devoured the scale. They had been on the place not quite a month, yet many branches could then

be seen entirely cleared of the scale. As soon as their value became known, persons came from far and near to see if they could secure a few specimens to place in their orchards. At the time of this visit, April 21, 1889, very few of the Vedalias could be seen.

A colony was also placed on a tree under a wire gauze tent at San Mateo. So great was their increase that in a few weeks a great many colonies were placed in different orchards throughout the State.

Previous to this visit the orange groves of San Gabriel and Los Angeles were in a very unhealthy condition; many of the trees were actually dying. Several of the growers whom I saw appeared gloomy and were at a loss to know what to do, and I was, indeed, sorry that I could not give them any advice that would ease their minds, excepting "to trust to luck, and hope for a change," but of what I could not tell. Within a month after my visit very encouraging reports came from most every person whose good fortune it had been to introduce the Vedalia into their orchards. Soon the news spread, and so did the Vedalia. Orchards that had been rendered comparatively worthless through the ravages of the cottony cushion scale were restored to their former condition, and to-day we can make known to the world that our orchards are again practically free from the ravages of this dreadful pest. Orchardists who had given up all hopes of saving their orchards are now jubilant over this "God-send," and are now preparing to plant more trees. *The cottony cushion scale is no longer a pest in California.*

Unfortunately for us, however, other scale insects attack our trees. At our meeting held at National City, April 19, 1889, the following resolution was unanimously adopted:

> *Resolved*, That we petition the honorable Secretary of Agriculture at Washington to send a special agent to Australia, whose knowledge and experience shall fully qualify him to collect and export into this country such parasites as are there found to be destructive to the various scale insects which have been imported here and are now disastrous to our fruit interests.

The Secretary of Agriculture, in acknowledging the receipt of our petition, said:

> Your petition is timely, and I abundantly realize the importance of the action which you suggest. During the winter of 1888-9 strong efforts were made by this Department to secure the removal of the restricting clause concerning foreign travel, with the idea that should Mr. Keobele's results warrant further importation of parasites, we would desire to send him or another agent again during 1889; in fact, to take just the action which you have petitioned us to undertake. This effort was apparently successful, and as the Entomologist understood the appropriation clause, passed Congress in this modified form. On my assumption to my present office, in discussing this matter with the acting Entomologist, I was put in possession of these facts, but was surprised to find, upon examination of the appropriation bill, that in some way which I cannot at this time explain, the restricting clause had been again inserted after it had been considered certain that it would be removed. The result is that the Department now finds itself in the same condition in which it was the past year, and the only hope of Government help in this matter will rest in securing independent legislation the coming winter. The Department will urge either the passage of an independent resolution or the addition of a clause to the appropriation bill, which will set aside enough funds for this purpose, and we hope for your earnest coöperation in this direction.
>
> Your Board should pass further resolutions and place them in the possession of the Senators and members of Congress from your State, urging such legislation, and in this way some action may possibly be brought about.

At the meeting of the Board, June 30, 1889, the sending of an expert entomologist to Australia, New Zealand, and other foreign countries, to search for and, if possible, introduce into this State the parasites, if any could be found, that prey upon scale insects of the various kinds, was duly considered, and the following resolution was unanimously adopted:

Resolved, That a special agent be sent to Australia and New Zealand, and to there collect such parasites that prey upon scale and other insects injurious to fruit and fruit trees; *provided*, that said agent shall not import into this State any such parasites that are injurious to fruit, fruit trees, and vegetation, but only those that prey upon any such scale and other insects.

The selection of an agent and all arrangements were left with the Executive Committee of the Board, with authority to act. The committee desiring to make no mistake, and as doubts were entertained as to the authority to send an employé of the Board outside of the State, this matter was referred to the Attorney-General. He replied that we had no authority to send an entomological expert to Australia or New Zealand, as the law is only with reference to our power and duties as defined.

While we have conquered the cottony cushion scale by the introduction of the *Vedalia cardinalis*, we feel that there exists in their native countries parasites that keep in check all the other scale insects.

Mr. Keobele reported that he could find only a few cottony cushion scales in Australia; they could only be found in gardens and sheltered places, the reason being that the parasites had destroyed them on the trees where they had been. It has only been a few years since Australia suffered as much or even more from the ravages of the cottony cushion scale than has our own State.

In accordance with the suggestions in the letter of the Secretary of Agriculture, at the meeting held at Fresno, November 8, 1889, the following memorial was ordered to be forwarded to the Senate and House of Representatives:

Your memorialists, the fruit growers of the State of California, in their annual Convention assembled at Fresno, California, this eighth day of November, 1889, most respectfully represent:

That the climate and soil of this State are adapted to the growth and preparation of fruits of good quality and in quantities sufficient, eventually, to supply the demand for such products in the United States, especially prunes, raisins, figs, olives, and olive oil.

That the success of this enterprise is of the greatest importance to the State and nation.

That the spread of scale insects imported from foreign countries, in California, threatens the continued successful cultivation of fruit trees subject to their ravages.

That parasites have been found in foreign countries, especially in Australia, that live upon and destroy the scale.

Your memorialists, therefore, respectfully and earnestly request an appropriation that will enable the Department of Agriculture to import to this country parasites for scale insects.

It is to be hoped that action on the above memorial will not be delayed. The beneficial effect of the *Vedalia cardinalis*, now so well known, may, perhaps, aid in the passage of the proper bill, to enable the Department of Agriculture to send one or more agents abroad in search of parasites and beneficial insects.

ACKNOWLEDGMENT OF MEMORIAL.

The following letters from Representatives Clunie and Morrow, and Senators Hearst and Stanford, are self-explanatory; others in relation to former memorials can be seen in Biennial Report for 1888–9, pages 282–3:

UNITED STATES SENATE,
WASHINGTON, D. C., December 12, 1889.

B. M. LELONG, *Esq., Secretary State Board of Horticulture, 220 Sutter St., San Francisco, Cal.:*

DEAR SIR: I am in receipt of your letter of the third instant, inclosing memorial from fruit growers of California, relative to an appropriation for the importation of parasites for the destruction of scale, and in reply beg to state that I will give the matter careful consideration.

Yours very truly,

GEORGE HEARST.

WASHINGTON, D. C., December 14, 1889.

B. M. LELONG, *Secretary State Board of Horticulture, 220 Sutter St., San Francisco, Cal.:*

DEAR SIR: Your letter of November eighth to Senator Stanford, in relation to memorial of Fruit Growers Convention of California, has been received. In reply, I am directed to inform you that it has been carefully considered and will be presented in the Senate.

Yours respectfully,

JOHN B. McCARTHY,
Private Secretary.

HOUSE OF REPRESENTATIVES, U. S.,
WASHINGTON, D. C., December 9, 1889.

B. M. LELONG, *Secretary Board of Horticulture, San Francisco, Cal.:*

DEAR SIR: Your letter received. I note what you say in relation to the spread of scale insects, and believe it to be the duty of the Government to make an appropriation that will enable the Department of Agriculture to take steps to rid the country of scale insects. Anything that I can do to secure an appropriation to rid the country of this blight and to give the fruit growers of the State of California that to which they are justly entitled, will receive my earnest efforts. Should any legislation come up during this session of Congress that affects the great interests committed to your care, do not hesitate to inform me of your wishes on the subject.

Yours truly,

THOS. J. CLUNIE.

WASHINGTON, D. C., December 14, 1889.

B. M. LELONG, *Secretary State Board of Horticulture, 220 Sutter St., San Francisco, Cal.:*

MY DEAR SIR: I am in receipt of your letter of the third instant, inclosing copy of memorial from the fruit growers of California in relation to the scale insects from foreign countries. I will have the memorial referred to the Committee on Agriculture, in behalf of the appropriation you request.

Very truly yours,

WM. W. MORROW.

THE LADYBUGS (COCCINELLIDÆ).

This family merits the principal credit of limiting the increase of other insects, its fondness for plant lice being well known. The rounded or hemispherical form of these insects, commonly known by the name of "ladybirds," and their dotted coloration, render them one of the most easily recognized of all the families of Coleoptera. Their three-jointed tarsi and the broad hatchet-shaped terminal joint of the maxillary palpi are their most distinctive organic characters. The tarsal joints are always dilated and cushioned beneath, and the second joint is deeply bilobed. These insects seem to be specially appropriated to keeping in check the extensive families of plant lice, both the leaf lice (Aphides) and the bark lice (Coccides), upon which they feed voraciously in both the imago and the larva states, and they are also known to devour the eggs of other insects. The larvæ are oblong, blackish grubs, and are usually thickly beset with spines, which are also furnished with smaller spines or prickles, giving them, when magnified, a formidable appearance. These, as in the case with other larvæ, are much more voracious than the perfect insects.—Dr. L. B.

The ladybird, or bug, feeds mostly on insect life, and only in exceptional cases have any of the beetles ever been found feeding on ripe fruit, and never on vegetation. The Diabroticas (squash and cucumber beetles), however, have often been confounded with the Coccinella.

EXPLANATION OF PLATES.

PLATE I. THE OLIVE.

Figure 1. *Picholine*—Showing the natural size and character of the leaf, pit, and fruit.

Figure 2. *Redding Picholine* (*Cal.*)—Showing the character of the fruit and leaf; natural size.

PLATE II. THE OLIVE.

Figure 3. *Columella*—Showing color of fruit when ripe; two thirds natural size.

Figure 4. *Uvaria*—Showing bearing character of the tree, color of the fruit, etc.; two thirds natural size.

PLATE III. THE FIG.

Figure 5. Longitudinal section of the fig (*White Adriatic*, *Cal.*), showing the fruits inclosed by the fleshy conceptacle.

Figure 6. The leaf of *White Adriatic* (*Cal.*).

Figure 7. Section of one-year old bearing wood, showing the size and shape of the *pith;* natural size.

Figure 8. *White Adriatic* (*Cal.*) fig; two thirds natural size.

Figure 9. Second crop fruit, showing rate of development, as the *first* crop matures.

PLATE IV. BENEFICIAL INSECTS.

Figure 10. *Vedalia cardinalis* (Australian Ladybird); enlarged.
Figure 11. *Vedalia cardinalis;* natural size.
Figure 12. Pupæ of *Vedalia cardinalis* on an orange leaf; natural size.
Figure 13. Larvæ of *Vedalia cardinalis;* enlarged.
Figure 14. Branch infested with *Icerya purchasi;* natural size.
Figure 15. Larvæ of *Vedalia cardinalis* at work.
Figure 16. Larvæ of *Vedalia cardinalis;* natural size.

BENEFICIAL INSECTS.

Plate IV

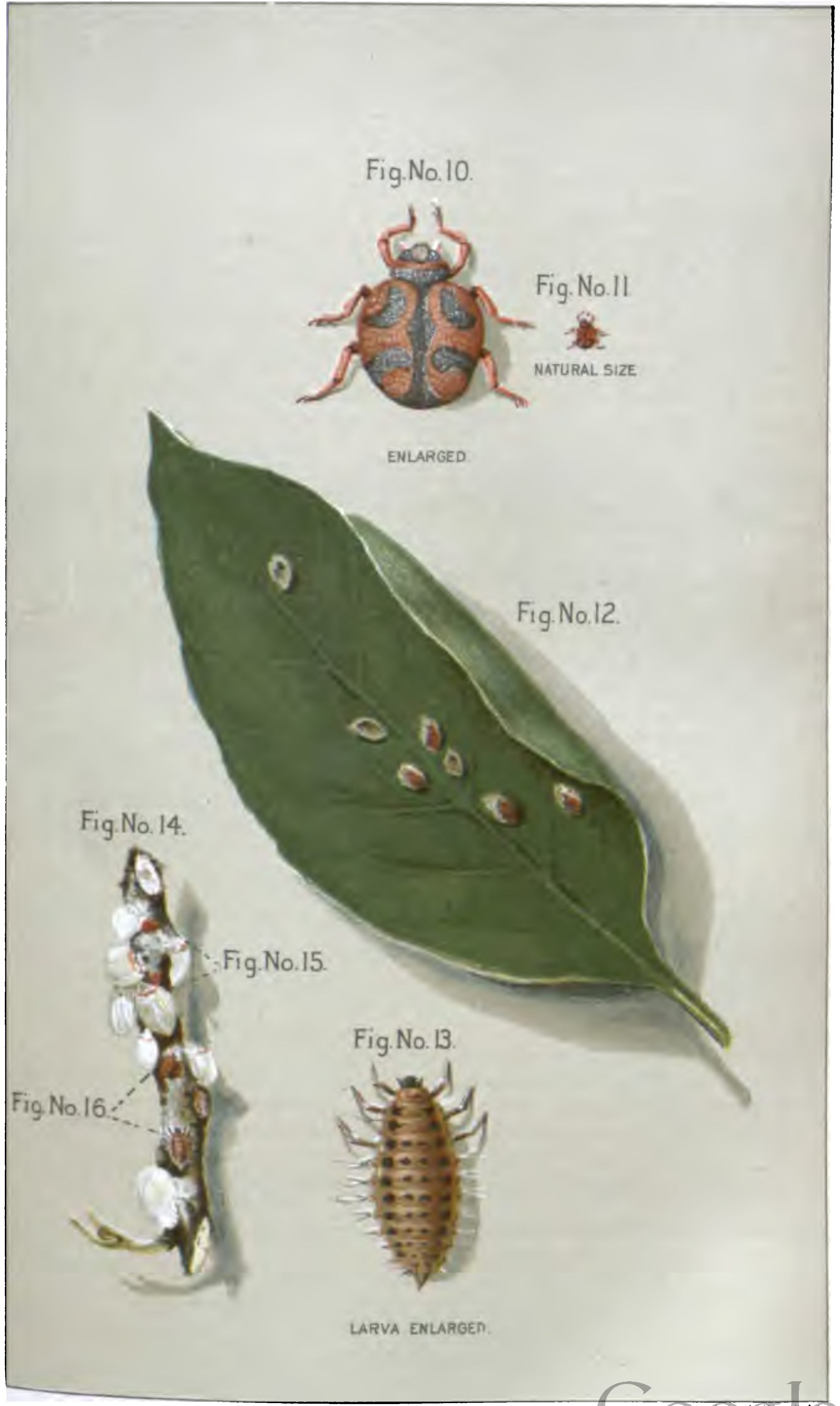


Fig. No. 10.
Fig. No. 11
NATURAL SIZE
ENLARGED
Fig. No. 12.
Fig. No. 14.
Fig. No. 15.
Fig. No. 16.
Fig. No. 13.
LARVA ENLARGED.

VEDALIA CARDINALIS.

AUSTRALIAN LADYBIRD.

Vedalia cardinalis, Mulsant.

(*Plate IV.*)

The introduction of the Australian ladybug (*Vedalia cardinalis*) has proved of untold value to the horticultural interests of this State, and especially to citrus culture.

Several years ago the cottony cushion scale (*Icerya purchasi*) was introduced into this State on trees imported from Australia. Since that time everything that could be done was done to exterminate it. All efforts failed, until the introduction of this little beetle, the *Vedalia cardinalis.*

So great were the ravages of the cottony cushion scale, on citrus trees especially, that in many districts the growing of the orange and the lemon was about given up, and, as Mr. Kercheval adds:

> More deadly than the hordes of Goths and Huns that came to plow Rome and harrow Italy, came the countless legions of Icerya, and shriveled foliage and bare and blasted boughs everywhere told of their resistless and ruthless march. No watchfulness or vigilance could guard against their attacks or turn them from their victorious course. Then, in the deep night of our despair came a miracle and relief. As silent and noiseless as came the angel of death to smite the Assyrians beleaguering God's chosen people, so came the Vedalia to our aid, and like Sennacherib's countless hosts, the cottony cushion legions almost in a night melted away and were no more. What a vast army of men and millions of dollars could not have performed in years, a mere handful of Australian ladybugs has virtually accomplished in a few weeks, and even to us who have watched their work most closely, it seems utterly incomprehensible, and almost beyond belief.

The original importations were colonized on trees in Los Angeles, the trees being previously inclosed with cheese cloth. A few months after their arrival in Los Angeles many more of the Vedalias were seen on adjacent trees than on those under cover. The larvæ had escaped through the cheese cloth and pupated outside. At the time of my visit to Los Angeles, last April (1889), the beetles and larvæ could be found on trees some distance from where it was originally intended to keep them under cover. The Vedalia increased with such rapidity that in a very short time many colonies were distributed throughout the State. Two colonies were placed on trees at San Gabriel; these were placed directly on the trees without cover. During my visit there, Mr. Chapman was able to show me only a few in the pupa state, and only one beetle was seen, although many larvæ could be seen actively at work.

So rapid was the increase and self-distribution of the Vedalia that in many instances parties carrying infested branches on which to transport the ladybird found, on examination, that they were "carrying coals to Newcastle," as the branches were full of Vedalias.

Mr. J. W. Wolfskill, of Los Angeles, upon whose trees they were first colonized, attended personally to the distribution of colonies to all who applied for them, and during one month distributed several thousand. Professor D. W. Coquillett, Special Agent United States Department of Agriculture, to whom the Vedalias were originally sent, and Mr. Alexander Craw (Mr. Wolfskill's foreman) also devoted much of their time to the distribution of many hundred colonies of the Vedalia. In San Gabriel, Colonel J. R. Dobbins distributed several hundred colonies from those on his place. By the first of August the Vedalia had almost exterminated the Icerya on this place, and as no more food existed on the trees, the larvæ descended, and thousands of them were seen crawling on the ground under the trees. Persons wishing colonies came to this place from many adjacent districts infested with cottony cushion scales.

The method used in gathering them consisted in taking to the orchard branches of trees infested with cottony cushion scales, and placing them on the ground under the trees; in a few moments the larvæ of the Vedalia would crawl on them; the branches were then lifted carefully and placed in boxes and carried in wagons to infested orchards. The limbs were then placed in the infested trees, and the larvæ allowed full freedom of the place. During my visit to San Gabriel, in September, 1889, I was unable to *see a single living cottony cushion scale.* Does not this seem truly wonderful?

The orchards visited showed a remarkable improvement. In those orchards many trees which had been badly infested previous to the introduction of the Vedalia, had ceased growing, and had also ceased fruiting; they had hardly made any growth during the past and present years; but those trees, I am happy to say, I found to be making a healthy growth. Some had made a growth of fully two feet, and in a short time all will have entirely recovered their vigor. A young orchard had made wonderful growth, and, save the dead scales that still hung on the trees, no trace of the ravages of the Icerya remained, and the same may be said of trees in adjacent orchards.

It will, of course, take a little time for the trees to entirely recover their vigor, but next year many of those once so badly infested will produce a good, medium crop, for the growth made this year is full of fruit buds. In another year these trees will produce a large crop, and of the very finest fruit, for *the cottony cushion scale is no longer a pest in California.*

The colony of Vedalias which I established at San Mateo did not increase as rapidly as those had at Los Angeles and San Gabriel, probably owing to the cool weather when they were placed there. During the month of May, however, I took from those trees several hundred beetles, and distributed them throughout the districts in the northern part of the State where the cottony cushion scale existed.

A colony was sent to Sacramento on May 24, 1889, and as the weather was quite warm they increased very rapidly, and were soon to be found on almost every tree and shrub infested with the cottony cushion scale.

Mr. Flynn, the officer I left in charge of them, distributed from those trees three hundred and seventy-seven colonies throughout Sacramento County. So rapidly did they increase at Sacramento that in October, 1889, Mr. Flynn reported that he was able to find but very few living cottony cushion scales.

The work of the Vedalia at this place has been thorough. The cottony cushion scale had infested all the citrus trees there, also the evergreens and shrubbery in the gardens. The large elm and poplar trees on the waysides had also been infested. Some of these trees are beautiful ornaments, being over forty feet high, but there seemed to be no other means of treating them than by cutting them down. There is now, however, no need of destroying such fine and valuable trees, for the Vedalia, after being placed there, reached every part of the limbs and destroyed its prey.

At San Mateo and Menlo Park the loss sustained by the ravages of the cottony cushion scale was also great. During the past few years many valuable trees were cut down. In one place the California laurel trees became infested. These trees are very large, being over forty feet in height, and the trunks of many measure over sixteen feet in circumference. "What is to be done?" was the question that agitated the minds of those interested, and, as Commissioner Kimball said when visiting the place, "It seems almost impossible to eradicate the scales on such trees," but since then the Vedalia has been distributed, and every vestige of scale destroyed.

Besides those mentioned above, I have distributed many colonies of the Vedalia in Santa Clara, Santa Cruz, Sonoma, Napa, Marin, El Dorado, San Joaquin, and Tulare Counties, and, in fact, have placed them wherever I learned that the cottony cushion scale still existed.

The Vedalia an Epicure.

Several experiments have been tried during the past summer for the purpose of ascertaining their feeding habits. So far as known, they feed only upon the cottony cushion scale. A colony was placed on a tree badly infested with the brown apricot scale. The beetles were seen alive two or three weeks after they were placed on the tree, but soon after this they disappeared. No larvæ were found on the trees. The beetles evidently did not lay any eggs on the tree. This conforms with what I saw at San Gabriel. The beetles were seen in great numbers on non-infested trees, running up and down the limbs in search of the Icerya, but nowhere on the trees were eggs of the Vedalia to be seen. A few of the beetles were captured and placed in a box containing branches infested with cottony cushion scales, and immediately upon entering the box they began to lay eggs upon the infested branches; and in no case could a single egg be found laid at any great distance from the scales. In almost every instance the eggs were deposited directly under, on, or near the scales, and the young, as they hatched, began at once to feed upon the scales. Another lot was placed upon a tree infested with woolly aphis. The result was reported to be the same, as the Vedalias would not feed on them. A colony was also placed upon a tree infested with plum aphis, with the same result. Dr. Kimball, of Haywards, however, reports that a colony he placed on orange trees infested with the soft orange scale fed upon them. At the time he placed them on the trees, the scales were young and soft; therefore, the experiment is worth further trial; but so far they cannot be induced to feed upon any other injurious insect than the cottony cushion scale. The most singular thing, however, is that, while they refuse to feed on other insects, they devour each other; the larger eat up the smaller ones.

Description.

Professor D. W. Coquillett, Special Agent United States Department of Agriculture, has described the *Vedalia cardinalis*, and gives a general account of its habits in Volume II, page 70, 1889, of a periodical bulletin of the Division of Entomology, called "Insect Life;" this article is herewith appended:

Early Stages

EGG.—Elongate-ovate, or rarely elongate-ellipsoidal, its width never more than one half its length; very rough, or scabrous; deep orange red; length, .02 of an inch.

LARVA.—Figures 13, 15, and 16, Plate IV (*First Stage*)—Dark orange red; first segment with two small black warts placed subdorsally, and with two long whitish bristles on each side; segments two to eleven each, with three dark brown warts each side—those on segments two and three situated in the subdorsal, supra-stigmatal, and stigmatal regions, while those on the remaining segments are situated in the dorsal, supra-stigmatal, and stigmatal regions; each of those in the stigmatal region bears two long whitish bristles, while each of the others bears a single shorter whitish bristle, those on the eleventh segment the longest; head about five sixths as wide as the first segment and slightly darker, its sides blackish; six thoracic legs orange red, the tibiæ darker; last segment furnished with a retractile proleg.

Second Stage.—Same as in the first, with these exceptions: Head about three fifths as wide as the first segment; this segment bears two additional bristles near each corner, and two others in front of the middle; second and third segments, each with an additional but much smaller wart in front of those in the stigmatal region, each bearing a single short bristle; bristles, except those in the stigmatal region, black, the warts in this region reddish, and larger than the others.

Third Stage.—Same as in the second, except that the head is proportionately narrower, being only about one half as wide as the first segment.

Fourth Stage.—Same as in the third, except that the warts in the subdorsal and suprastigmatal region on either side of the third, and usually of the segment, are connected by a black spot, and the body finally becomes covered over with a light gray powder; length when fully grown, .23 of an inch.

PUPA.—Figure 12, Plate IV.—Partially inclosed in the old larval skin, which is of a whitish color, marked with black dots, which indicate the position of the warts on the larva as described above; this skin is rent from near the front edge of the first segment to the middle of the eighth; the exposed part is mottled light and brownish red, the first segment marked with two dorsal black dots, or the entire dorsum of this segment, and also that of the second and third segment, black; abdomen with a polished black interrupted dorsal line; length, .16 of an inch.

The following table exhibits the length of time passed by these ladybirds in their different stages:

Egg Laid.	Egg Hatched.	First Molt.	Second Molt.	Third Molt.	Pupated.	Beetle Issued.
April 20.	Apr. 26.	May 3.	May 5.	(?)	May 14.	May 21.
April 23.	Apr. 29.	May 3.	May 7.	May 15.	May 19.	May 26.
	Apr. 27.	May 3.	May 5.	May 11.	May 19.	May 26.
	May 6.	May 11.	May 14.	May 19.	May 29.	June 5.
		May 11.	May 13.	May 17.	May 23.	May 31.
			May 9.	May 12.	May 20.	May 26.
			May 17.	May 22.	May 31.	June 5.
				May 10.	May 17.	May 25.
				May 11.	May 19.	May 27.
				May 12.	May 19.	May 27.
					Apr. 25.	May 4.
					Dec. 5.	Dec. 18.

AVERAGES.—*Egg*, six days. *Larva*, nearly twenty-two days (*i. e.*, first stage, five and a half days; second stage, two and three fifths days; third stage, five and one sixth days; fourth stage, seven and five ninths days). *Pupa*, seven and three fourths days. Egg to beetle, a little over thirty-five days.

Three of the beetles which issued from the pupa May fourth were kept in a breeding cage in a sunny window of my office and supplied with an abundance of food; one of them died on the twentieth of May, another on the twenty-sixth, and the third died on the fifth of June. It is probable, therefore, that in the open air in summer, the beetles live about four weeks after issuing from the pupa, so that their existence from the time the egg is laid until the adult which originated from it dies a natural death covers a period of about two months. During the colder portion of the year, however, this period is doubtless extended considerably beyond this limit, as will be seen by reference to the above table; for instance, the larva that pupated December fifth was changed to a beetle thirteen days later, whereas the one that pupated May thirty-first produced the beetle five days later.

Habits and Natural History

The eggs are usually thrust beneath the Iceryas, but are sometimes attached to the cottony egg masses; they are placed on one of their sides, sometimes singly, but usually in pairs or in groups of three or more. In hatching, the egg shell is rent nearly the entire length along its upper side, and after the young larva has issued the shell becomes of a whitish color and retains nearly its original form. The recently laid egg is more slender and of a deeper red color than the egg of the Icerya.

The young larvæ usually burrow into the egg mass from below and feed upon the eggs; later they attack the Iceryas of all sizes, usually making the attack on the under side of the abdomen. The young larva is easily distinguished from the young Iceryas by lacking the long black antennæ so conspicuous in the latter. When about to cast its skin the larva attaches the posterior end of its body to some object, and at the proper moment breaks away the whole anterior end of the old skin and crawls out of the opening thus made.

When about to pupate the larva attaches the posterior end of its body to the bark or leaf of the tree, and suspends itself head downward. It remains in this position about three days, when the skin along its back splits open, exposing a portion of the pupa to view. When the beetle is fully formed the old pupa skin partially breaks away, showing the beetle to be of a pale reddish color. It remains in this situation about two days longer, when the beetle issues clad in its normal colors of black and red, as shown in the figures (Nos. 10 and 11, Plate IV.) Coition occurs shortly afterward. In fact, I have frequently seen the males standing by and waiting for the females to issue, even going so far as to tear away the old pupa skin, and uniting with the female while she is still soft and helpless. Egg laying begins the next day, and is continued during nearly the entire life of the beetle. One that I kept in a breeding cage, and supplied with an abundance of food, deposited forty-two eggs in eight days. The total number deposited by one female will probably average from one hundred and fifty to two hundred eggs.

The adult beetles as well as the larvæ also feed upon the Iceryas, but with this difference, that the attack is usually made from above instead of from below.

I have never seen these ladybirds in any of their stages feeding upon any other insect than the Icerya. On one occasion I confined six ladybird larvæ in a breeding cage containing black scales (*Lecanium olea*, Bernard), some of which were quite soft, but after the lapse of seven days none of these scales had been attacked, whereas three of the ladybird larvæ had been devoured by their comrades. At the same date I placed an equal number of these larvæ in another cage containing specimens of an undetermined species of Lecanium found on a peach tree, several of the scales being still soft, but at the end of seven days none of them had been attacked, while four of the ladybird larvæ had fallen a prey to their rapacious brothers. I also tested these larvæ with a species of plant louse found on orange trees, but they did not attack them. It seems very evident, therefore, that the Iceryas are the natural food of these ladybirds, and they feed upon these in all their stages, even attacking the winged males.

I have never seen any of our native insects attacking these ladybirds, although Col. J. R. Dobbins informs me that on one occasion he saw a lace-winged fly larva (Chrysopa sp., unnamed) in such a position that he thought it might have been engaged in feeding upon a ladybird larva. The ants do not molest them.

Importation and Spread.

The first consignment of these ladybirds reached me on the thirtieth of November, and numbered twenty-eight specimens; the second consignment of forty-four specimens arrived December twenty-ninth; and the third consignment of fifty-seven specimens reached me January twenty-fourth; making one hundred and twenty-nine specimens in all. These, as received, were placed under a tent on an Icerya-infested orange tree, kindly placed at my disposal by Mr. J. W. Wolfskill, of Los Angeles. Here they were allowed to breed unmolested, and early in April it was found that nearly all of the Iceryas on the inclosed tree had been destroyed by these voracious ladybirds. Accordingly, on the twelfth of April, one side of the tent was removed, and the ladybirds were permitted to spread to the adjoining trees. At this date, I began sending out colonies to various parts of the State, and in this work have been greatly aided by Mr. Wolfskill, and his foreman, Mr. Alexander Craw, both of whom were well acquainted with the condition of the orchards in this part of the State. By the twelfth of June, we had thus sent out ten thousand five hundred and fifty-five of these ladybirds, distributing them to two hundred and eighty different orchardists; and in nearly every instance the colonizing of these ladybirds on Icerya-infested trees in the open air proved successful. The orange and other trees—about seventy-five in number—and also the shrubs and plants growing in Mr. Wolfskill's yard have been practically cleared of Iceryas by these ladybirds, and the latter have, of their own accord, spread to the adjoining trees to a distance of fully three fourths of a mile from the original tree.

Besides the three consignments of these ladybirds referred to above, I also received two later consignments. The first of these reached me on February twenty-first, and numbered thirty-five specimens. These I colonized on an Icerya-infested orange tree in the large orange grove belonging to Colonel J. R. Dobbins, of San Gabriel. The last consignment of three hundred and fifty specimens arrived March twentieth; one third of these I left with Colonel Dobbins, while the remainder I colonized on orange trees in the extensive grove owned by Messrs. A. B. & A. Scott Chapman, in the San Gabriel Valley. All of these colonies have thrived exceedingly well. During a recent visit to each of these groves I found the ladybirds on trees fully one eighth of a mile from those on which the original colonies were placed, having thus distributed themselves of their own accord. The trees I colonized them on in the grove of Colonel Dobbins were quite large and were very thickly infested with the Iceryas, but at the time of my recent visit scarcely a living Icerya could be found on these and on several of the adjacent trees, while the dead and dry bodies of the Iceryas still clinging to the trees by their beaks, indicated how thickly the trees had been infested with these pests, and how thoroughly the industrious ladybirds had done their work.

TWICE-STABBED LADYBIRD.

Chilocorus bivulnerus, Mulsant.

The length of the larva, Figure 108, is .23 of an inch. The body is covered with many long spines, each of which is armed with delicate supplementary spines. The color is entirely black, with the exception of the first abdominal segment, which is light yellowish, the spines the same color as the segment, except at the tips, where they, too, are black.

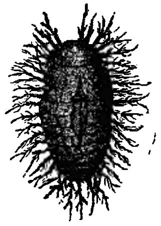


Figure 108.

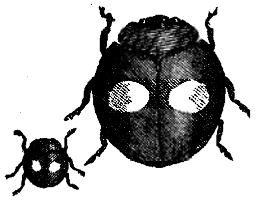


Figure 109.

[This pretty little beetle, with bright red spots on its wing covers, resembles the *Coccinella oculata*, and has often been described as such. It also resembles the *Exochomus pilatei* (also a ladybug with two red spots), but is much smaller, the *Exochomus* being the largest of these three species.]

The pupa is formed within the larval skin, which simply splits along the back sufficient to show the inclosed pupa, bnt still remains around it and protects it. The pupa is perfectly smooth, with the exception of sparsely scattered tufts of fine hair, shining and black in color. The beetles themselves are shining black in color, with an irregular reddish spot on each wing cover.

PILATE'S LADYBIRD.

Exochomus pilatei, Mulsant.

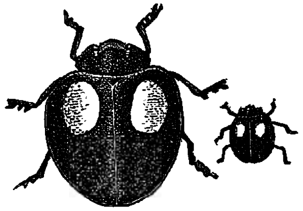


Figure 110.

The larva of this species quite closely resembles that of the twice-stabbed ladybird, but is of a lighter color, and attains a larger size, the full grown larva measuring 8 mm. in length. The pupa is formed within the old larval skin, the latter simply splitting along the back, as in the preceding species; the exposed part of the pupa is of a pale yellowish color, and is marked with two rows of black spots.

The beetle is larger than the twice-stabbed ladybird, and may easily be distinguished from it by having the posterior part of the underside of the body black, whereas in the preceding species this part of the body is reddish.

This species feeds very largely upon the black scale (*Lecanium oleæ*).

The editor of the "Azuza Pomotropic," states that on one occasion he confined one of the larvæ in a box with about one hundred and fifty black scales, and that by the end of the third day every one of the scales had been eaten by this larva.—Coquillett.

This species is mostly found in the southern part of the State. At one time I confined several beetles in a box, four days after the box was opened; their food had become exhausted and the larger beetles had eaten up the smaller. The larva of this species is larger and quite different from that of the other species; it is of a light reddish color, and has a flat head. After the escape of the beetle, the pupa case becomes of a white color and the spines black.

THE EYED LADYBIRD.

Coccinella oculata, Say.

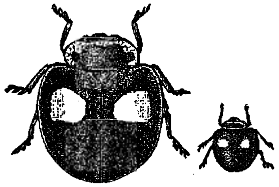


Figure 111.

This species is not very common in this State, and I cannot find it mentioned in any of the lists of insects occurring east of the Rocky Mountains. It hardly seems possible that the form figured above belongs to the same species as the one figured below, yet it is so regarded by our best authorities. Upon this subject, Dr. G. H. Horn, our best authority on this group of insects, writes me that, "As strange as this may seem to you, it is a demonstratable fact. *Exochomus* and *Chilocorus* have species resembling the typical *Oculata*, but these have a very different thorax."

I inclosed several ladybird larvæ in one of my breeding cages, supposing that they belonged to the same species, and from them I bred both the typical form of *Oculata*, as figured above, and also the variety *Abdominalis*, the larvæ and pupæ of these two forms being indistinguishable.—Coquillett.

This species resembles *Chilocorus bivulnerus* and *Exochomus pilatei* very closely, the beetles of these three species having two red or yellow spots on the wing covers. There is, however, a very marked difference. The spots on the wing cases of this species are yellow, while those of *Bivulnerus* and *Pilatei* are bright red. These latter species have no markings about the head and thorax, as in this species.

ASHY GRAY LADYBIRD.

Coccinella oculata (var. *Abdominalis*), Say.

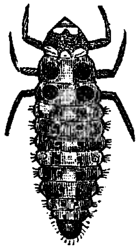


Figure 112.

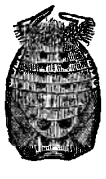


Figure 113.

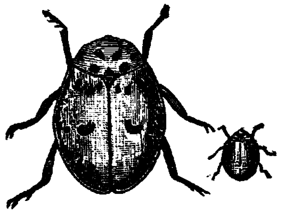


Figure 114.

This very pretty beetle is found abundantly upon different kinds of infested trees throughout our State. It is mostly found on citrus trees infested by the black scale (*Lecanium oleæ*). According to Comstock, "the length of the larva when full grown is .4 of an inch; color spotted, with dirty greenish white, black, and orange above; face yellow, remainder of head black; prothorax black; irregularly margined before and behind with light yellow; mesothoracic segment with a broad longitudinal dorsal yellow stripe; metathoracic segment with a broad central dorsal spot; each of the abdominal segments except the last, with a dorsal yellow spot, which upon the fourth abdominal segment is very broad; segments one and four each with a pair of subdorsal yellow spots; all segments except the last with a row of lateral yellow spots on each side. There is a pair of small subdorsal black spots to each abdominal segment, and much larger ones to the meta and mesothoracic segments. Upon abdominal segments two, three, five, six, seven, and eight, is also a pair of small dorso-sublateral black spots."

When about to transform to a pupa this larva attaches itself to a leaf by the end of its abdomen, and the skin, splitting at the back of the head, shrinks back about the posterior end of the body.

The length of the pupa is .14 of an inch; of broad oval shape, the width being about .2 of an inch; general color white, tinged in some lights with purplish; around margin slightly yellowish; wing covers yellowish; all spots black, those on the thorax and wing covers resembling, in form, size, and position, those on the adult insect. On the dorsum of each abdominal segment, except the first, is a transverse row of four black spots. These are largest on the third segment, and decrease in size toward posterior end of body, those upon the second segment being very small. There are also small black lateral spots on the third and fourth, and a trace of one on the fifth, segment.

The adult beetle is a small ashy gray insect of the usual semi-globular shape. There are seven black spots on the thorax, and eight upon each wing cover, of the size and shape indicated in the figure.

AMBIGUOUS LADYBIRD.

Hippodamia ambigua, Le Conte.

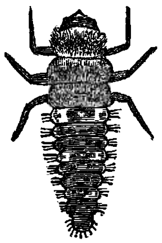


Figure 115.

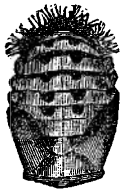


Figure 116.

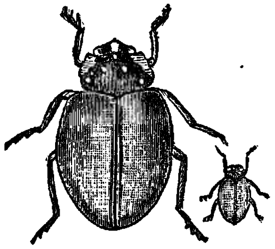


Figure 117.

This species is very abundant, and is found in almost every section throughout the State where fruits are grown. The length of the larva (Figure 115) when full grown is 10 mm.

Color, bluish black above, dirty green below; first thoracic segment margined with yellowish white; abdominal spots, bright orange and black. The orange spots are arranged as follows: Two small spots on the posterior part of the metathoracic segment, and a larger one on each side just above the leg; the first abdominal segment with large subdorsal and lateral spots; second abdominal segment with small lateral spots, which are really the endings of two long lateral spots, beginning on the metathoracic and extending across the first abdominal segment; fourth abdominal segment, with subdorsal and lateral spots a little smaller than those on the first; sixth and seventh, each with small subdorsal spots.

The length of the pupa is .23 of an inch; width .14 of an inch; general color, dull orange yellow; prothorax yellow, with a dark, sometimes black, margin, a black spot on either side the median line on both front and hind margins, also another on each side just external to those on the hind margin. In some specimens there are two dusky discal spots on the prothorax, which sometimes extend forward and unite with the middle anterior marginal spots. The wing cases are tipped with black; the legs are black, and the abdomen furnished above with a double row (almost, if not quite, continuous) of black spots.

The adult beetle resembles the blood-red ladybird, but is narrower in proportion to its length, and is flatter. The thorax is black, with its two fore corners dirty white. The head is black, with the middle of the forehead whitish. It is about .23 of an inch long.

CONVERGENT LADYBIRD.

Hippodamia convergens, Guerin.

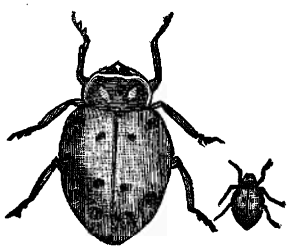


Figure 118.

This is quite a common species and is found throughout the State. In the summer it is found very plentifully in among corn and vegetable growth. The larva feeds on other insects. The beetles also feed on insects such as aphis, young black scale, etc.; they also have been observed feeding on ripe fruit, but only after other insects or birds had first eaten into it.

BLOOD-RED LADYBIRD.

Coccinella sanguinea, Linn.

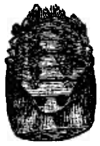


Figure 119.

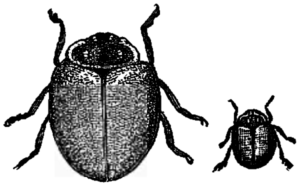


Figure 120.

This beetle is not very common, and is only occasionally met with. The length of the pupa (Figure 119) .2 of an inch, and the width .14 of an inch.

"Shape, broadly oval. General color of body, dirty yellow; median line of thorax of a light orange color; first, fourth, and fifth abdominal segments terminate laterally with bright orange-colored spots, and the fourth abdominal segment bears two dorsal spots (one on each side of the median line) of the same color; there is also a subdorsal row of black spots on each segment, except the second abdominal; wing covers, blackish.

"The adult beetle is small (.2 of an inch long), and is almost hemispherical in shape. Its color varies from brick-red to blood-red; thorax, black, with two orange spots, and edged with the same color; and head, black, with two light spots."

CALIFORNIA LADYBIRD.

Coccinella transversoguttata (var. *Californica*), Mann.

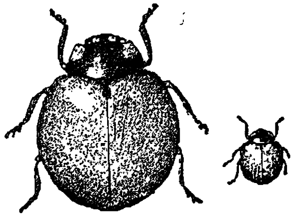


Figure 121.

This ladybird is a California variety, and is a form with no spots. The wing covers are of pale orange color; its thorax is black, and has on each side a pale spot. This is a very common species, and the beetles, at times, have been found feeding on ripe fruit, but only that which had fallen and was partly broken or bird-eaten.

MINUTE SCYMNUS.

Pentilia coccidivora, Ashmead.

Figure 122.

This is one of the smallest of the ladybug family. The beetles can be seen on orange and other trees infested with scale, red spider, or aphis. The beetle is very minute, but after once becoming acquainted with it, it can always be detected. Being so small and insignificant, persons are led to doubt that it is of much benefit. This little beetle, however, accomplishes a great deal in the destruction of scale and other insects. Besides feeding on scale insects it has been observed feeding on the red spider and on aphis. The larva is very small, generally hatching in the spring, when they immediately begin their warfare upon the young scales, red spider, and aphis, continuing the warfare even after they have transformed into beetles.

Dr. Horn described the Minute Scymnus for Mr. Ashmead as follows: "Broadly oval, convex, piceous, shining; each elytron with a large, badly defined, rufous space, which sometimes reaches the side margin and suture; thorax sparsely, finely punctate; elytra more coarsely punctured; body beneath and legs piceous, shining; length, .04 inch. This insect resembles some of the smaller Scymnus, but is entirely without pubescence. It is

not larger than *Pentilia pusilla*, and from its resemblance to that insect, except in color, would have been referred to that genus; but there are six abdominal segments."

While on the tree, the beetle is quite active; and on being touched draws in its legs and rolls off the leaf or branch, and before reaching the ground generally expands its wings and flies away.

BROWN NECK LADYBIRD.

Scymnus marginicollis, Mann.

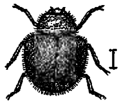


Figure 123.

This little ladybug may be seen on trees infested with scale, but mostly on trees infested with red spider. To the naked eye it appears deep black and shiny, and at the touch drops or rolls off of its perch, but before striking the ground spreads out its wings and flies away. The color of the body is yellowish gray, and is thickly covered with white mealy powder. The head is black and the neck brown. The wing cases are black and covered with hair, as shown in the cut, Figure 123 (greatly enlarged). This ladybug is not very numerous in orchards, and does not seem to increase as rapidly as the others, and therefore the benefit derived from it amounts to but little.

SPOTTED PSYLLOBORA.

Psyllobora (*20-maculata var.*) *Taedata*, Le Conte.

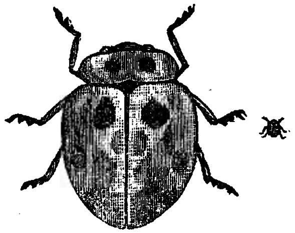


Figure 124.

The larva of this species resembles that of the ashy-gray ladybird (*Coccinella oculata*), but is of a lighter color, being pale gray, marked with a few black and yellow spots; when full grown it measures only .1 of an inch in length. The pupa also resembles that of the above species, and its colors are the same as in the larva; it measures .08 of an inch in length.

I have seen both the larva and the adult beetles engaged in feeding upon the common red spider (*Tetranychus telarius*).—Coquillett.

This little beetle is mostly found on orange trees, and on garden plants, or wherever black scale and red spider abound.

Lace–Winged Flies, or Aphis Lions.

Nearly all the species of the sub-family *Chrysopinæ* pertain to the genus *Chrysopa*. These insects are known in the adult state as lace-winged flies, and in the larva form as aphis lions. The antennæ of the adult are long and setaceous. The venation of the wings resemble somewhat that of the sub-family *Hermerobiinæ*, but the subcostal and median veins are separate, and the transverse veins of the costal space are not forked. The lace-winged flies are very common insects throughout the summer months upon the foliage of trees, especially on citrus trees. They are usually of a light green color or yellowish. While alive their eyes are very bright, and on this account they have also received the popular name of golden-eyed flies. Some species, when handled, emit a very disagreeable odor.

A remarkable fact in the history of these insects is the way in which the female cares for her eggs. When about to lay an egg she emits from the end of her body a minute drop of a tenacious substance; this is drawn out into a slender thread by lifting the abdomen, then an egg is placed on the summit of this thread. The thread dries at once and firmly holds the egg in mid-air. These threads are usually 0.4 to 0.6 of an inch in length, and occur singly or in groups. It is probable that this placing of the eggs on stalks protects them from the ravages of predaceous insects, including the aphis lions themselves. When the young aphis lion (larva) hatches, it crawls down the thread that held up the egg, and starts in quest of some small insect or egg which it can feed upon. While doing so it may wander through a forest of egg stalks, not observing the eggs far above it. The larvæ are spindle-form, and have long, sickle-shaped mandibles. They feed chiefly on plant lice, but will eat such other insects as they can overcome. The cocoon in which the pupa state is passed is spherical, and composed of dense layers of silk. In order to emerge the insect cuts a circular lid from one side of the cocoon.

LACE–WINGED FLY.

Chrysopa sp. (Unnamed.)

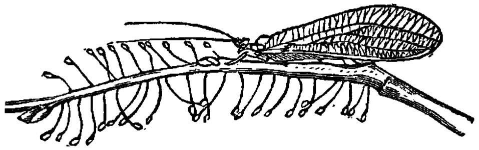


Figure 125.

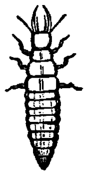


Figure 126.

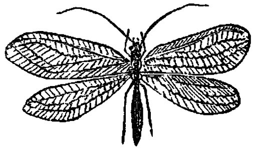


Figure 127.

This insect is among the most beneficial of insects, destroying scale and other injurious insects. The fly is bright green; antennæ, light brownish, longer than the wings, and finely annulated; dark reddish brown at base, extending to one third the length. The head is yellow, with three dark spots on occiput, just back of the neck. The wings are hyaline, iridescent, length to tip, .67 inch; veins, greenish; length of body from head to end of abdomen, .33 inch; eyes, bright golden, large, and very prominent.

The fly lays its eggs at the end of delicate silver threads, nearly half an inch in length; they are generally found on the upper part of the leaves, but not always, for I have seen the eggs attached to the under part of the leaf, on the young and old branches, also on the young and old bark of the trunk, and have also seen them on very delicate and tender weeds, infested with aphis. The eggs are elongate oval, about .05 of an inch in length, and of a greenish yellow, or very light purple, according to age; very light when freshly laid, changing with age as stated. As the young hatch, the empty egg-skin is of a very transparent white. The larva resembles somewhat the ant lion (*Myrmelion Sp.*), which lives in pits in the ground; of a pinkish color, and mottled with brown spots. The larva in devouring its prey secures them by its long, curved mandibles. When full grown, the larva forms an oval cocoon, and in a few days transforms into a perfect fly.

There are other species of Chrysopa which I often come across, which are also beneficial. One of these resembles the one above described, its color being light brown, instead of green. Mr. Albert Keobele also brought one from Australia, where he found it preying on scale and other insects. All of these are as yet undescribed.

SYRPHUS FLIES.

Sp. (Unnamed.)

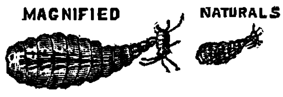


Figure 128.

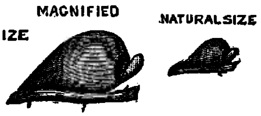


Figure 129.

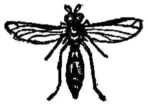


Figure 130.

The larva of the syrphus flies is of great benefit in destroying all kinds of aphis. It is quite blind, but the egg from which it hatches is deposited by the parent fly in the midst of a colony of plant aphis, where it gropes about and obtains an abundance of food without much trouble. The larva is fleshy, thick, and blunt behind and pointed in front. (See Figure 128.) Their mouths are furnished with a triple-pointed dart, with which they seize and pierce their prey, and, elevating it as shown in the figure, deliberately suck it dry.

The flies (Figure 130) are black with transparent wings, and are prettily ornamented with yellow stripes across their bodies. They are generally found on trees infested with black scale (*Lecanium oleæ*) or on trees infested with aphis.

The larva when ready to change, fastens itself to a leaf or stalk by means of a glutinous secretion from its own body, and the outer skin, contracting into a pear-shaped case (see Figure 129), soon hardens by exposure to the air; the pupa is formed inside. After a few days, the perfect fly emerges from a hole at the blunt end of the case, to lay eggs among colonies of aphis. The fly has two transparent wings, its body is generally more or less banded with brown, black, and yellow, and it has the appearance of a diminutive wasp.

DEVIL'S HORSE, OR WHEEL BUG.

Prionidus cristatus, Linn.

The illustration furnishes a good example of the habits of the predaceous members of this family. This insect is mostly found on orange and lemon trees, where scale insects are numerous, also on trees infested with aphis. The adult, a cluster of eggs, and several nymphs are represented in the

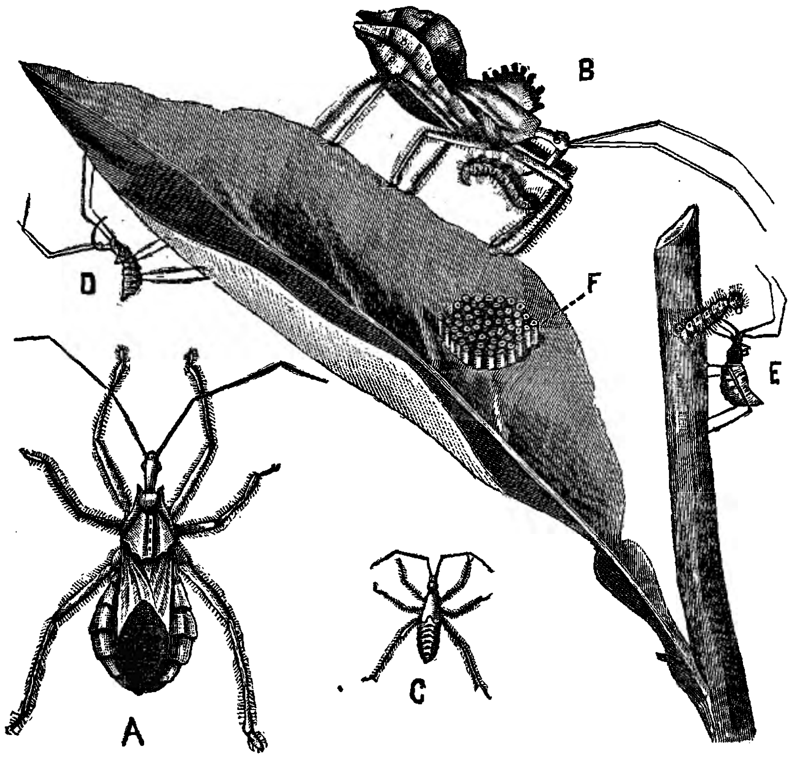


Figure 131.

[(*a*) Adult insect. (*b*) Adult insect devouring a caterpillar. (*c*) Larva. (*d*) Larva. (*e*) Larva devouring a caterpillar. (*f*) Eggs, as they are generally laid on the leaf in clusters—magnified.]

figure. The hexagonal masses of eggs are deposited on the bark of trees, on fence rails, under the eaves of outbuildings, or wherever the female chances to be at the time of oviposition, to the number of seventy or more. The nymphs, when young, are blood-red, with black marks, and do not resemble the adult insect, excepting somewhat in form and in habits. Both the nymphs and adults feed upon all other insects they can overcome, not even sparing their own kind.—Comstock. They kill their prey by inserting into it the proboscis, which injects a most powerful poisonous liquid into the wound. The victim thus pierced dies in a very short time. They then leisurely suck the juice out and drop the empty skin. The perfect insect is of a gray color, and has a high semicircular ridge or projection on the crest of its thorax.—Glover. This insect can always be seen through the summer months; those who prune trees become well acquainted with their larvæ and that of the lace-winged fly, as they inflict severe wounds on the hands and neck of the pruner by action of their mandibles.

TRUE PARASITES.

Dilophogaster, Howard. (Synonym, *Tomocera*, preoccupied.)

Tarsi five-jointed; middle tibiæ without a strong spical spur; antennæ inserted immediately above the mouth, ten-jointed (female), nine-jointed (male); joints of the funicle in the male compressed, and each with a strong prominence above and many long hairs; antennæ clavate with the female; head very wide, acutely margined behind; eyes wide apart; ocelli forming a very obtuse angled triangle; maxillary palpi two-jointed; mandibles three-dentate; labial palpi two-jointed; parapsides of mesoscutem distinctly separated; scapulæ quite widely separated from each other; abdomen ovate, slightly pedunculate; marginal vein short, not so long as stigmal; postmarginal very short, longer in male than in female.

BLACK SCALE (L. OLEÆ) PARASITE.

Dilophogaster californica, Howard.

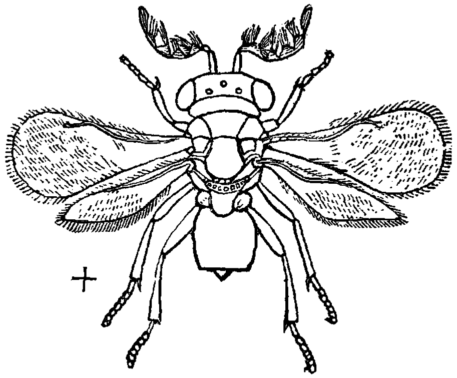


Figure 132.

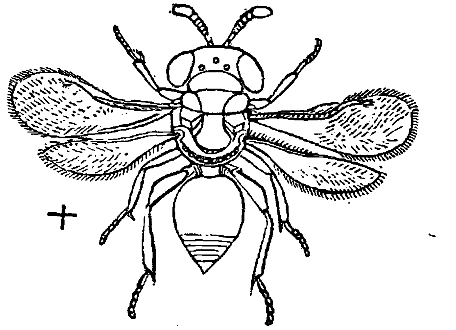


Figure 133.

This parasite is highly beneficial in keeping the black scale (*Lecanium oleæ*) in check. The following from a well known entomologist is not out of place: "Thirty years ago the orange trees in Los Angeles were at death's door by reason of the soft orange scale (*Lecanium hesperidum*); now this scale is seldom met with, being kept in subjection by a parasite. A few years ago the black scale (*Lecanium oleæ*) was many times more dreaded than now; once a serious pest, it is now being rapidly subjugated by this parasite."

Prof. J. Henry Comstock, when in California on an official visit, discovered this useful parasite, and Mr. Howard describes it as follows:

Female.—Average length of body, .08 of an inch; average wing expanse, .13 of an inch; greatest width of forewing, .026 of an inch. Head with a delicate sculpture; all of the thorax, except the scapulæ, with fine longitudinal punctures above; metascutum and postscutellum with a number of coarse indentations; many stout bristles sparsely scattered over dorsum of thorax. Abdomen subovate, somewhat flattened dorsoventrally, smooth and shining; first segment very large, but the other five are plainly distinguishable. On each side of the pedicel on the anterior part of the first abdominal segment is a strong tuft of snow-white hairs. Wing veins strong, dark, bristly, the stigmal making a very small angle with the postmarginal. Color: Head, face, scape of antennæ, and the under side of all legs, light mahogany-brown; thorax black, with strong metallic luster on prothorax, tip of scutellum, and scapulæ; abdomen bluish black, with a slight brownish patch beneath at base; flagellum of antennæ blackish, with short, dark hairs; border of the eyes at the top of the head bluish; front and middle coxæ light brown, hind coxæ shining blue-black above, brownish below and at tip; all femora blackish above; middle and hind tibiæ blackish above; front tibiæ brownish; front tarsi yellowish, last joint black; middle tarsi whitish; hind tarsi with first and fifth joints blackish, others yellowish. The center of the forewing is occupied by a large, dusky, circular patch, the inner edge of which is darker than the rest.

Male.—Length, 1.5 mm. General color deep metallic blue-black; antennæ with the scape yellow-brown, the remaining joints darker; all legs light yellow-brown, except hind tibiæ, which are blackish; wings perfectly clear.

Described from twenty-five females, three male specimens.

Parasitic upon *Lecanium oleæ* (black scale), Los Angeles.

This is one of the most interesting parasites, both structurally and economically. It lives upon the destructive "black scale," and so abundant is it in certain regions, that Professor Comstock states that, upon more than one tree, at least 75 per cent of the scales appeared to be parasited. In no locality was the black scale found without this attendant destroyer.

Genus Aphelinus (Dalm).

Antennæ eight-jointed; joint one (scape) quite long and slender; joint two large, subconical; joints three and four very small; joint five as long as or longer than two, and subcylindrical; joints six, seven, and eight compacted into a large club; joint eight at tip with several minute bristles, only seen with a high magnifying power. Mesoscutum wider than long, parapsides distinctly separated, small. Mesoscutellum very broad and short; subusiform (except in *A. abnormis*, where it is pointed anteriorly), unicolorous. Middle tibial spur long, slender, as long as first tarsal joint. Forewings each with an oblique hairless line extending from the stigma backwards to the posterior border of the wing, at a point little more than half way from the base to the stigma; the remainder of the wing, except near the base, with equally distributed pile; stigma small and inconspicuous, club-shaped, rounded at tip. Species generally unicolorous, either blackish or yellow, very seldom metallic.

SAN JOSÉ SCALE PARASITE.

Aphelinus fuscipennis, Howard.

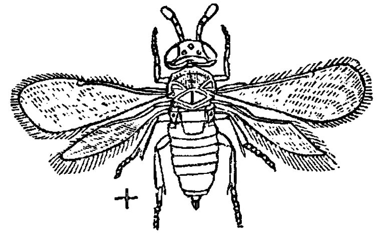


Figure 134.

The first account of this parasite is the following, by L. O. Howard (Report Department of Agriculture for 1880):

> Length of body, 0.06 mm.; expanse of wings, 1.3 mm.; greatest width of forewing, 0.2 mm. General color, dull honey yellow; antennæ fuscous, almost black at tip; eyes blackish, ocelli dark crimson; a distinct transverse black band on the occiput behind the eyes; scutellum a little blackish at tip; abdomen with five dusky transverse lateral bands; legs and wing veins honey yellow. Forewings with an indefinite fuscous patch below stigma, and another well defined, darker, somewhat crescent-like streak near the base, convex proximally.
>
> Described from nine female specimens; male unknown, but in all probability it is very similar to the female.
>
> This species is parasitic upon—
>
> *Mytilaspis* sp., on pear (San José, Cal.).
> *Mytilaspis* sp., on Euronymus (Fort George, Fla.).
> *Mytilaspis* sp., on orange (District of Columbia).
> *Mytilaspis* sp., on horse-chestnut (District of Columbia).
>
> This seems to be a very widespread species. It comes nearer to *A. diaspidis* than to any of the other species, but seems well separated by its size and the distinctness of the fuscous wing patches.

Mr. A. Scott Chapman, of San Gabriel, on May 6, 1888, wrote me as follows:

> Mr. J. W. Wolfskill and Mr. Alexander Craw, of Los Angeles, having noticed the progress of the San José scale at Los Angeles, were for a time at a loss to account for its disappearance. A close examination revealed the fact that they were being killed by a minute parasite. Last week, Mr. Alexander Craw and myself visited a place on Jefferson Street, in the southern part of the city, where the pear trees last year were very badly infested, some of them having died; now they are looking green and thrifty, and much of the new growth is two feet long.
>
> It is hard to find a living specimen of the scale, and many of the dead scales show little holes in them where the parasites have hatched. Mr. Craw says that the parasite is the same as the one that works on the willow scale.

The orchard reported as having been freed of the pernicious scale (*Aspidiotus perniciosus*) was visited this summer, the parasite was found to exist in great numbers, but the trees were still in a very badly infested condition, and, to all appearances, the scale had been spreading. A large lot of infested branches were however secured and placed in an orchard in San Gabriel, and another lot in orchards in Sonoma County, at which places their propagation will be undertaken, and it is to be hoped that they will multiply rapidly enough to be distributed to other orchards.

Genus Coccophagus (Westw.).

Antennæ eight-jointed; scape rather short and stout; pedicel one third the length of scape and of about the same thickness; joints three, four, and five increase very slightly or not at all in thickness, and decrease in length; club very plainly three-jointed and a little longer than the preceding two joints. With the male the club is often less compact than with the female, and is narrower. Mesoscutum large, its posterior body with a slight reëntering angle; the sutures between the parapsides and scapulæ very oblique. Mesoscutellum nearly as long as broad, rounded behind, the fore part forming three sides of a hexagon, the side bordering upon the scutum being a little shorter than the other two. The parts of the metanotum upon profile appear as three subequal bands. Wings equally hairy, except just at base; no hairless line. Stigma small, but usually colored so as to be plainly seen, subtriangular in form. Middle tibial spur usually not as long as first tarsal joint, usually curved. Species usually of somber colors, often with two contrasting colors—black and yellow.

RED SCALE PARASITE.

New Species (*Unnamed*).

A parasite near the genus Coccophagus has made its appearance in the orange groves in the San Gabriel Valley that are infested with red scale (*Aspidiotus aurantii*). It has thus far done great good. In a recent communication Professor D. W. Coquillett says:

> Concerning the parasite of the red scale in the San Gabriel Valley, Acting Entomologist Howard writes me that it is probably a new species belonging near to the genus Coccophagus. It is a minute, four-winged fly, scarcely as large as the head of a small pin; its eggs are laid singly in or upon the scales, and the larva or grub that hatches from this egg feeds upon the scale insect, and after completing its growth and passing through its preparatory stages, it gnaws a round hole through the scale and thus makes its escape. This parasite occurs in nearly all of the orange groves in the San Gabriel Valley, and in some of them its work is very noticeable. This is especially the case in Chapman's large grove, in which I detected this parasite two years ago; during a visit to this grove a few days ago it was almost impossible to find any young red scales on the infested trees, while in other localities where this parasite does not occur almost every leaf contains one or more of the young scales, this being the season of the year when they are the most abundant. Mr. A. B. Chapman informs me that there is less red scale on his fruit this year than there has been since his trees first became so seriously infested with these pests. I have taken the necessary steps for introducing this parasite into a locality where it did not previously exist, but it will be several months yet before the result of this experiment can be determined.

A colony was placed on trees infested with *Aspidiotus aurantii* at Marysville. Several orchards in San Gabriel have been comparatively freed from red scale through the work of this parasite. The orchards have been very badly infested and no spraying has been done for several years past.

BROWN OR SOFT SCALE PARASITE.

Coccophagus cognatus, New Sp.

Female.—Length, 1.2 mm.; wing expanse, 2.1 mm.; greatest breadth of fore wing, 0.34 mm. Antennæ not quite so long as thorax. General color, dark brown, nearly black; last half of mesoscutellum and tip of metascutellum, orange yellow; anterior coxæ, femora, and tibiæ fuscous, tarsi whitish, last two joints slightly dusky; middle femora and coxæ nearly black, tibiæ

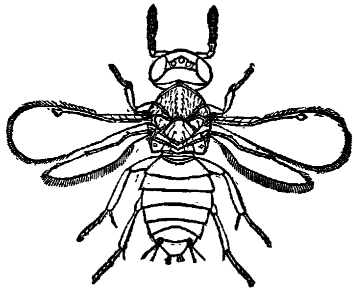


Figure 135.

somewhat dusky, tarsi as with fore tarsi; hind coxæ, femora, and tibiæ dark, tarsi as with others.

Male.—Length of body, 0.6 mm.; expanse of wings, 1.4 mm.; greatest breadth of fore wing, 0.25 mm. Antennæ nearly as long as head and thorax together. General color, brown; scutellum and metascutellum just tipped with light yellow-brown. In all other repects resembles the female.—Howard.

Described from eight females, three male specimens.

Parasitic upon *Lecanium hesperidum*, Linn., on orange trees.

Genus Gyrolasia, Forst. (Pterothrix West).

Tarsi four-jointed; submarginal vein broken before reaching the costa; marginal vein reaching only to middle of wing; scutellum, smooth; wings with long cilia; antennæ seven-jointed with the male, with long hairs; the female, six-jointed.

ALEURODES SCALE PARASITE.

Gyrolasia flavimedia, New sp.

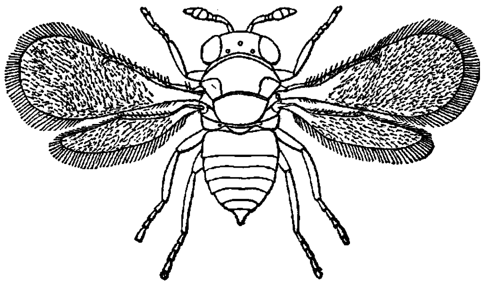


Figure 136.

Male.—Length, 0.7 mm.; expanse of wings, 1.9 mm.; greatest width of forewing, 0.32 mm. Antennæ short and sparsely covered with stout hairs; scape, rather slender; pedicel broader than scape, twice as long as broad; funicle two-jointed, joint one narrower than pedicel and very short; joint two somewhat broader and longer than one; club longer than pedicel and funicle together, rounded at base, pointed at tip, plainly three-jointed, large, and conspicuous. General color deep black, with slight metallic reflections on dorsum of thorax; second and last abdominal segments bright orange color, but when the abdomen is bent upward, the color of the second segment is nearly if not quite hidden. Scape of the antennæ black, remaining joints yellowish brown; tarsi yellowish, last joint black; all legs black; under side of abdomen yellowish, as are also the mouth parts and a patch of the prosternum, into which the front coxæ are inserted; wing veins black and very distinct; forewings, with a large, dusky patch below the submarginal vein.—Howard.

Described from many male specimens; females unknown.

Parasitic upon *Aleurodes* sp., on *Iris*. Collected at Los Angeles, California.

FLORIDA SCALE LIMACIS.

Limacis aspidioticola, Ashmead.

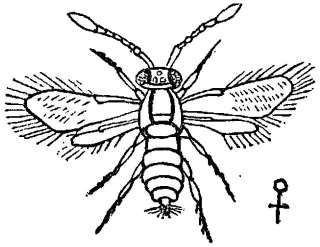


Figure 137.

This minute chalcid fly, according to reports, has been of great benefit in keeping the red scale in check in many orange groves in Florida. In speaking of its beneficial effect, Mr. Asmead says:

It was but a few years after the orange groves of Florida had been blasted and ruined by scale insects that this wonderful and welcome foe of these pernicious pests made its appearance. It is one of the chief agencies in holding them in check, and I am firmly satisfied, could these minute foes be removed but for a season, the numerous scales would so increase in numbers as to utterly destroy all orange trees, and another panic in orange culture would ensue, as disastrous and uncontrollable as the one witnessed in the years 1835 to 1840. How important, then, is it for us to study the life histories of these destructive insects; to seek out their habits, find their likes and dislikes, discover their foes, and thus by this means, if by no other, control and keep the injurious insects in subjection. What a glorious science, then, is entomology to the fruit grower, agriculturist, and florist!

Its First Appearance.

The first account we have of this little friend is that given by Glover in his report on orange insects, in the United States Agricultural Report for the year 1855. He says: "Another hymenopterous fly came out of the dead scales, which also measured about the twentieth part of an inch in length, the thorax and first segment of the body being light brown, with the rest of the abdomen blackish and hairy; the head was furnished with three ocelli; the four wings were transparent, and the antennæ long, jointed and hairy.

Its Natural History.

It is about .02 of an inch in length; of a light brownish color, with four wings, ciliated, and agrees very much with the description of the Aphelinus of the apple tree (*A. mytilaspis*), found preying upon the apple scale insect (*Mytilaspis pomorum*), but differs in the following respects: it is smaller, the abdomen is considerably longer than thorax, with the wings ciliated but from just before the apex; antenneæ, too, is different. It lays its eggs, a single one, under each scale, among the eggs of the scale insect. On hatching, the larva, which is a white, fleshy, footless grub, immediately begins feeding upon them. After it has destroyed all the eggs, and has reached full growth, it changes into a pupa, remaining in this condition for a few days; it then transforms into the four-winged fly, as described above, making its exit from under the scale by eating a round hole at the top.

I would recommend the introduction of Limacis into orchards badly infested with scales, in which these flies do not appear. Le Baron, State Entomologist of Illinois, successfully transported the Aphelinus of the apple scale (*A. mytilaspis*) into apple orchards, and the experiment proved not only successful but beneficial. It can easily be accomplished by taking branches infested with scales, that are known to have been chalcidized, and tying them on the infested trees.

Description.

Female.—Length about .02 of an inch. Head wider than thorax, both light reddish brown, head nearly same width as thorax, three ocelli forming a triangle, compound eyes prominent, dark; antennæ eight-jointed, setaceous, first joint larger than two, three, four, and five, second joint round, nearly twice as wide as third, other joints gradually increasing in size, somewhat truncate anteriorly, last or apical joint large and club-shaped; legs yellowish, long and setaceous, with a tibial spur; tarsi long, five-jointed; wings, hyaline, ciliated from stigma, with numerous small, short bristles on the surface; abdomen longer than thorax, upper surface of segments more or less dusky, blackish towards apex, with several hairs surrounding ovipositor.

Male.—Agrees very much with above description, excepting it is slightly smaller and scape or first joint of antennæ is shorter and broader, the other joints more rounded than in the female, with red spot on thorax at base of each wing, with upper surface of abdominal segments dark brownish.

I have made arrangements to have several colonies imported into this State from Florida, and it is to be hoped that they will multiply as rapidly as the report states.

GENUS COSMOCOMA (FORST).

Tarsi four-jointed; antennæ club not jointed; abdomen petiolated; fore-wings widening gradually, the marginal vein appearing as a dot.

OAK SCALE PARASITE.

Cosmocoma elegans, New sp.

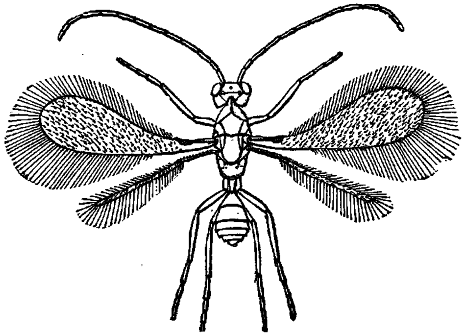


Figure 138.

Male.—Length, 0.9 mm.; wing expanse, 2.1 mm.; greatest width of fore-wing, 0.18 mm. Antennæ thirteen-jointed, considerably longer than the whole body; scape very short, broadened; pedicel of the antennæ brown, the rest black; all tarsi entirely light honey yellow, except the last joint, which is nearly black; wing veins nearly black.—Howard.

Parasitic upon oak scale (*Kermes* sp.), Santa Rosa, Cal.

XXX.

FRUIT GROWERS' CONVENTIONS.

SYNOPSIS OF PROCEEDINGS OF THE TENTH STATE FRUIT GROWERS' CONVENTION.

[Held under the auspices of the State Board of Horticulture, at the City of Chico, commencing Tuesday, November 20, and ending Friday, November 23, 1888.

Pursuant to notice issued by the State Board of Horticulture, a convention of fruit growers, shippers, packers, nurserymen, and others interested in horticulture and kindred pursuits in California, assembled in Pythian Hall.

The exercises were opened with prayer, by Rev. N. R. Peck, of Penryn.

Hon. Wm. Johnston, of Richland, Sacramento County, and Mr. Geo. M. Gray, of Chico, Butte County, were, upon motion, elected Vice-Presidents by acclamation.

ADDRESS OF PRESIDENT COOPER.

Ladies and Gentlemen: This will be the tenth Fruit Growers' Convention, and the sixth held under the auspices of the State Board of Horticulture.

At the ninth Convention, held in Santa Barbara, ninth to twelfth of April last, I urged very fully the subjects which I deemed of greatest importance to be considered. There have not been any material changes in the fruit-growing interests, so that I refer you to the opening remarks made at that time.

Our last biennial report is now ready for distribution. It comes down to July of this year. Contains, besides the reports of officers, the transactions of the Santa Rosa Convention, held in November, 1887, and the one held in Santa Barbara, April of this year. We consider this report of great value to all those interested in fruit growing; we also recommend the previous report of 1885 and 1886—to be had on application at our office, 220 Sutter Street, San Francisco.

Before reviewing the last report I make mention that this is the first time in the history of the Board that we have been able to present the work so promptly to the fruit growers. It has been accomplished by the great energy and indefatigable efforts of our Secretary, B. M. Lelong, for which he has the heartfelt thanks of the Board, and will have the thanks of every fruit grower who peruses it.

The report is here for gratuitous distribution, and I trust every member of this Convention will avail themselves of the opportunity to procure a copy. Some reference was made in my opening remarks, referred to, of the difficulties the Board had to encounter, and it is pertinent in this place to mention that the appropriation last made for the expenses of the Board, the time between March 31 and June 30, 1887, was overlooked, so that we had no funds for April, May, and June; all expenses incurred during those months remain unpaid. The deficiency should be met by a special appropriation at the next meeting of the Legislature

We turned back to the State Treasury $2,762 71 of unused funds, and yet by an oversight we could not recover for the expenses during said three months. I refer you to page 17 of that report.

The appropriation is totally inadequate for the demands. I, as a member of the Board, have been called upon to advance money to procure materials, because parties are unwilling to wait so long to get a warrant, and then submit to a discount to get the cash. A certain sum of money should always be in the hands of the Treasurer for immediate use.

I submit for the action of this Convention to adopt some measure asking the Legislature for a larger appropriation, and a different disposal of the funds appropriated.

I recommended on page 161 further consideration of the subject of distribution of fruits. Since that Convention there has been organized a Dried Fruit Association, to protect the dried fruit interests, as also raisins and nuts. The fullest discussion is invited on this subject.

It is also important that this Convention should have the benefit of the result of the auction plan as practiced by the California Fruit Union of sales of shipments of ripe fruit in eastern markets for the last crop.

I recommend that the subject of protection to fruit industry be omitted from our programme at this Convention.

The ravages of the *Icerya purchasi* become more and more alarming. The gas remedy appears to be given up, and, so far as I have been informed, no radical warfare has been made against the pest.*

The United States Department of Agriculture, Division of Pomology, are soliciting coöperation of the fruit growers, to prepare a display of fruits for the Paris Exposition of 1889. Should the Convention desire to take any action regarding this request it will be in order to do so. I therefore recommend that the subject form a part of our programme.

No fruit in California at the present time claims so much attention as the olive. A great deal has been written. Conflicting reports have created an inquiry that cannot be satisfied, there being no experience to ratify statements made.

Arthur Tappan Marvin, of San Francisco, has compiled quite an elaborate work, principally translations from Italian books, recently on sale, in which certain statements are made, which may or may not be true, there being no experimental fact to determine. At any rate, what has been said about the Redding picholine being nearly allied to the wild olive, and comparatively worthless, has created alarm amongst the growers.

This variety has been planted by the thousands. It is important and necessary that we should investigate these statements, so as to prevent the planting of new orchards of worthless varieties, or should the publications have no foundation in fact, then to allay the alarm created by them.

If there are varieties in Europe so greatly superior to the Mission, we should make every effort to get them for general cultivation in California.

I again urge that we ought to encourge forest tree planting for the protection of our fruit trees.

Our fruit industry is rapidly increasing from year to year. Our fruits are sought by the people in almost every part of the country; we have a growing demand with an increased interest in our products.

Shall we keep pace in our efforts so as to profit by it? We should give our greatest energies to improve our methods by producing better varieties—take greater pains in picking, packing, and drying, and put on the market in perfect condition at reasonable prices.

---

*Since that time the *Icerya purchasi* has been practically exterminated, through the introduction of the Australian ladybird (*Vedalia cardinalis*).

Proper distribution will be the greatest obstacle to our success. We must not relax our efforts in educating the people, in insisting upon transportation facilities, and in doing everything that will harmonize our efforts for our success.

All personal prejudices should be overcome by that which is more important—universal good.

With these few remarks, ladies and gentlemen of this Convention, I submit these questions for your consideration.

ADDRESS OF WELCOME.

Delivered by Rev. E. Graham, of Chico.

Ladies and Gentlemen: The old play-writers were accustomed, before producing the substance of their play, to construct what they called a prologue; that is, something by which the general nature and character of the play which was to follow might be determined.

The distinguished gentleman who was to address you this morning, General Bidwell, has delegated to me the position of speaking the prologue of what is subsequently to follow. I, however, must cast myself upon my Yankee tendency to guess somewhat as to what shall be the nature and character of the play you are to perform, for I am no horticulturist myself, as you know from the official designation by which I have been introduced, still I have had the pleasure of reading the admirable biennial reports which you have issued, to which reference has been made in the address of your President, and from them I gather something of the general aims of your meeting.

I take it for granted that you are those that were spoken of by a very talented literary gentleman (Carlyle) as those who "cause to grow one blade of grass where a blade of grass never grew before," and that each of you is, therefore, "of more value to the world than fifty warriors."

This indicates, I think, the character of your avocation. You are not accustomed to the roar and rattle of machinery, nor to the clash of arms, nor to those peculiar antagonisms that arise sometimes out of commercial and political affairs, but you walk in the quiet vales of Agriculture, you live in the sunlight, you listen to the hum of the bee and the voice of the warblers of the forest, you study those things that lead you upwards, following the trailing vine as it climbs upward to the skies, and there is only one step, it seems to me, between your vocation and Paradise itself, a very short one to the garden wherein all flowers ever grow and wherein luscious fruits are always picked.

Now I think it is very proper that *we*, here in Butte County, should give you a most hearty greeting, for we are, *par excellence*, horticulturists and agriculturists, and we flatter ourselves that however distinguished you may be personally or as an association, we are in such a position as to give you a hearty and universal welcome.

I have not the slightest doubt but that you all represent the "garden spots of California;" each one of you lives in the finest climate and in the very best part of California. Well, let me assure you that you have not traveled beyond that boundary; that you may feel perfectly at home while you are within old Butte, for we, too, claim that we are in the "garden spot of California." It is true that we cannot boast very much of our sunshine this morning, but this is, you know, "*exceptional in our district.*" I have not the slightest doubt but what you have also had to make apology for your sections sometimes in having rain when you have expected and desired sunshine. I can assure you, however, that we have sunshine *in all its glory;* indeed, I am reminded of the fact that one of the most distinguished horticulturists of our State, Judge Talbot, of Tulare, describes that belt of land which stretches from Red Bluff, on the north, to Bakersfield, in the south, as being the "*sunshine belt of California,*" having the distinguished eminence of being "above the fog belt and below the cloud belt," indicating that it is really the home of the fig, of the pomegranate, and of the orange, which you can see here represented to-day. We therefore say this downpour is exceptional; at the same time you, no doubt, understand how we also appreciate the abundant rains which, with the sunlight, make up the glory of the land, bringing to us the fruits and flowers in which we so much delight. You can, therefore, pardon us for giving you a drenching to-day.

In other lines also, I think we have, if not the preëminence, very near the preëminence; we can show you "big things" up here in Butte. I have not had the opportunity to get correct statistics as to our area or productions, but I venture the assertion that Butte will compare favorably with your most extensive areas and most varied productions. We have what, perhaps, might be called the "biggest farm in the world," at least a very distinguished Scotch gentleman, who called on me the other day, gave me the assurance that he had the opportunity of examining into horticulture and agriculture all the world over, and he gave us in Butte County the preeminent distinction of having "the largest detail thoroughly cultivated farm in the world;" there may be modifications, of course, in some sense. We have also, as Sir Joseph Hooker has said, the biggest oak in the world, and he, I venture to say, is an authority upon that subject. We, I think, can present you with one of the biggest cherry trees in the State of California, if not in the world, and I think, perhaps, we can show you also the largest grain farm in the world, within the boundaries of Butte County; at least we have only to step across the border and beguile ourselves with the belief that we are still in Butte County, and assure you of the fact that we have the largest grain farm in the world.

We have a great many things that are beautiful. I would, however, we could this morning present to you one of the biggest things we boast of, one of the largest hearts in the world, that would give you a welcome such as I never could speak.

He is a virtual production of Butte County, and we are as proud of him in Butte as Santa Barbara County is of your distinguished President, and Sonoma is of her pioneer hero, General Vallejo, whom we are proud to greet here to-day.

Our honored citizen is absent, as has been referred to by the President of the Convention, or from the fullness of that big heart I am sure you would have such a welcome as would gladden you and give you to understand that if we are not the biggest in everything, we are at least the biggest in appreciation and hospitality.

I cannot, of course, inform you very correctly of the varied industries of the county, but I will take it for granted that you have eyes such as will search out for yourselves its capabilities, and by which you will be assured that you have come to a place that none of you can afford to despise, and that you, perhaps, would like to understand more thoroughly. You will find, too, after your examination, that this is the spot of all others that

comes up to the famous saying that, "if you tickle the ground with a hoe, it will laugh a harvest." We can assure you that there is nothing that is worth producing, either in agriculture or horticulture, that cannot, in a measure, and in most cases to perfection, be produced in Butte County, and the difficulty, indeed, is to select, in the whole scope of horticulture, anything that will not grow in Butte County.

And we can also assure you that we do not require the abundance of irrigation that is required in some counties that are represented here, giving us, I think, a special prominence in the matter of horticulture and agriculture, reducing the price of the productions of our cereals and fruit, and commending itself to every horticulturist as the very home of fruit and flowers. But to come to a special point, I have no doubt at all that I am expected to represent to-day something that I cannot fully express, and that is the great desire on the part of our people that you should feel entirely at home among our citizens—among the people of Butte County.

My embarrassment results not simply because you are a distinguished class of people, an honorable class of people individually, but because you represent to such a high degree the great qualities and conditions of life in which we live. If I should attempt to express the sentiment which is before your mind to-day, and deep down in the hearts of our people, I should say to you truly that *every latch-string of old Butte is at the portal,* every door is open, and every heart brings its gladdest welcome to make you feel at home while you are with us. I should say, also, that all things seem to combine to increase our gladness and swell our welcome. Those flowers around us bloom for you to-day. The orchards are dropping upon you their richest fruits, the vineyards are pouring out their vintages, the very "trees of the field are clapping their hands," and the benedictions of all hearts, I trust, will rest upon you and linger with you when you go from us, until you again return to gladden us and receive the most abundant welcome that we can possibly confer.

INSECT PESTS.

Essay by H. P. Stabler, Yuba City.

Fruit culture in California is now assuming vast proportions, and every department is being thoroughly worked up by energetic men. The Fruit Union has proven itself eminently successful and insures a market for the California fruit grower in the East for an almost unlimited output of green fruit. The Dried Fruit Association will doubtless do the same for him for his dried fruit. The success of these two enterprises at once puts the fruit business in this State on a sound basis commercially, and no doubt will be the cause of many engaging in the business in the near future.

But there are yet serious hinderances to the ultimate success of the business, which, if not overcome and counteracted, will in a great measure reduce the profits and may seriously cripple what now promises to rank with the most prominent industries of the State. Undoubtedly the greatest threatened drawback to the success of the fruit interests of the State is the prevalence of depredating insects on both tree and vine.

Nearly every branch of industry is afflicted by injurious insects. Earth, air, and the sea swarm with them. All crops throughout the country are more or less injured by them, and many are entirely ruined by their depredations. Cotton and tobacco in the South, potatoes and corn in the West, and wheat and rye in the North, have often been rendered entirely profitless by their devastation; but it is the fruit grower of California who suffers most from the depredations of pests. The tree in the nursery, the tree as it grows in the orchard, the fruit on the tree, and the fruit after it is dried, are often infested with pestiferous insects.

Our climate—so mild and equable—is wonderfully favorable to the propagation and dissemination of insect pests. While almost every known horticultural product of the world will grow and flourish in some part of California, the pests that infest it, owing doubtless to the salubrity of the climate, will also multiply and spread to an incalculable extent. Not only have we to contend with almost every pest that is congenial to other climes, but with some species that only exist to a considerable extent in this State.

Many of our enterprising citizens who have imported trees, plants, and scions from foreign countries are doubtless responsible for the introduction and subsequent spread of some of our worst pests; but however it happened, we know that the pests are here, and it looks as though their eradication was going to be a difficult problem to solve.

The orange growers of the southern part of the State are unpleasantly familiar with the cottony cushion scale, now (November, 1889) practically exterminated, the peach and prune growers of upper California have been forced into a reluctant acquaintance with the pernicious scale, and the apple and pear growers are sorely troubled with codlin moth and woolly aphis. The ravages of pests in this State alone annually amounts to tens of thousands of dollars, and unless effective laws are enacted by our Legislature and stringent measures adopted and followed by ourselves, the loss will certainly increase at a fearful ratio.

I am not prepared to say that the present laws on the subject are not sufficient for the purpose designed, but if they are wanting in any essential particular, they should be speedily amended and made to conform to the necessities of the case. It does not seem to be so much the deficiency of the laws applicable to the matter in hand, as the non-compliance with them by interested parties.

From the fact that pests spread from orchard to orchard, through some process not well understood, thus rendering the thorough and scientific spraying and disinfecting of one man useless, unless his neighbors adopt the same course, the most stringent and binding methods should be adopted and inflexibly pursued, to contest every inch of progress made or threatened by pests.

The inventive genius of the American people has placed in the hands of the modern horticulturist adequate and efficient appliances for the destruction of these insidious enemies. The law has also wisely provided for an officer, whose duty it is to examine orchards, experiment with the nature and habits of insect pests; to ascertain, invent, and promulgate remedies and outline the best methods of their application for the destruction of the pests; to import known parasites if possible, and generally to assist in every possible manner to attain the end desired. Such an officer now exists, and is believed to be worthy and competent. He is doing his duty in a careful, laborious, and painstaking manner. All else to be done remains with the fruit growers. They should organize, in every fruit-growing section of the State, horticultural societies. Every fruit grower, however small his possessions may be, should become a member, and every member should regularly attend the meetings. The local Inspector of Fruit Pests and Quarantine Guardian should have at all times the full and vigorous moral support of every member.

It is notorious that in many fruit-growing sections of the State some orchardists annually expend much time and money in spraying, cleansing, and pursuing other well known modes in exterminating pests, while adjoining owners neglect their orchards, knowing them to be infested, thereby affording a hotbed and breeding place for the worst of pests. Vigorous and well directed efforts, and a thorough and efficient concert of action, seems to be what is needed. Efficient remedies are known to the skilled pomologist, and can be ascertained and procured by every one. They should always be applied at the full standard of strength, and in the most thorough and exhaustive manner, and by every one who has an infested tree. A community can be infested from one tree planted in a houseyard, and it is highly important that every fruit grower should be well versed in the time of application. When the insect is in its incipient state it is much more easily killed than when it approaches maturity and takes on its defensive armor.

Every infested tree should be repeatedly and thoroughly cleansed at the proper time, and in default thereof immediately removed and destroyed. From a limited experience I am convinced that apathy on the part of the fruit growers of California is the best friend that the insect pest has as yet found. Persons who have but a few fruit trees for family use seem to be the most careless in respect to their condition. They obtain their income from some business other than fruit growing, and therefore give their trees little or no attention. Of course it would not pay the latter class of persons to purchase and keep in order a full complement of appliances for the destruction of pests, or to learn from others versed in the matter the most approved remedies for that purpose, but the fact still exists that the dissemination of these little enemies to the orchard comes largely from the foul trees of the small grower; therefore, it should be obligatory on the part of such owners, to either keep their trees in a healthy state, or else remove them. Almost any progressive orchardist would apply the remedies for a nominal consideration, his main benefit accruing from the fact of the destruction of the pests.

This should be brought about and rendered compulsory by stringent statutory enactments, or by a strong public opinion, or by the watchful care and persistent importunity of local societies of intelligent pomologists, or by all of these agencies.

Many of the intelligent, experienced, and progressive California orchardists seem to be derelict in contending against the spread of injurious insects. They do not vouchsafe to the subject the importance it deserves. They do not realize that unless prompt and vigorous preventive measures are pursued their property is constantly deteriorating. It is not enough to wait until the enemy appears, and appreciable damage is done, before action is taken. A preventive is always better than a cure. The orchardist should be untiring in his warfare. He should disinfect and spray upon knowing the threatened danger, and that, too, with the same regularity that he prunes and cultivates, regardless of labor, and almost regardless of expense.

The continuous and necessary custom of transporting scions and nursery trees to and from all parts of the country, of itself foreshadows the danger, and the unwritten history of scores of dilapidated and ruined orchards in many parts of the State fully demonstrates it.

The frequent and instructive meetings of this and other similar organizations, attended by fruit growers, bring home to their minds a full and ample knowledge of remedies, and they should be applied with alacrity. The cost is inconsiderable compared with the benefit.

I believe that, with a unity of action and with a wholesome individual energy on the part of the fruit producers, the prevalence of injurious insects in California will be materially lessened, and they may be exterminated.

DISCUSSION.

A general discussion on insect pests followed, in which the universal opinion was expressed that all insect pests can be kept under control, if not entirely exterminated, by united and persistent work; that the laws on this subject now on our statute books should be enforced, and if said laws are not sufficient new laws should be enacted that would meet the difficulties.

The various remedies and modes of application were also thoroughly discussed. The rules and regulations of this Board, however, give all the approved remedies and methods that have proven to be the most practical after experiments and actual use in the orchard.

The remedies for the worst of our insect pests, the cottony cushion scale, are now useless, as the wonderful Vedalia has almost entirely destroyed this pest.

It was evident from the discussion that the fruit growers of California do not intend to allow any pestiferous insects to interfere with the growing of fruits for profit.

PEACH CULTURE.

Essay by P. W. BUTLER, Penryn.

Since the harvesting of the peach crop of this season (1888) many leading fruit growers and fruit dealers have been consulted, that the very latest data might be obtained relating to the production and disposition of this popular fruit. It is the general opinion that while peaches can be grown in most parts of California with the certainty of a fair average crop, yet in only a small portion of the State can they be grown with satisfactory profit. It is at points where it has been proven that they grow in the greatest perfection that peach orchards should be planted, and great care should be exercised in selecting the location. For table use, peaches require to be highly colored, of excellent flavor, and large in size. These qualities are obtained in the highest degree where orchards are planted on sloping hillsides, on undulating land that is well drained, where there is entire freedom from fogs, and continuous sunshine during the period of ripening. If peaches are to be sold fresh in the markets of the East, the orchard must not be distant from a main line of railroad transportation. If for canning or drying, lands more remote from railroads may be profitably used, because of their being cheaper.

VARIETIES TO PLANT.

In planting for shipment East, the varieties of freestones now preferred, ripening in the order mentioned, are the Alexander, Hale's Early, Foster, Susquehanna, Late Crawford, Brandywine, Salway, and Bilyeu's Late October; of clingstones, the Tuscan, Albright, George's Late, and Levy (or Henrietta). These varieties ripen in regular succession, beginning in May and ending in October. For canning or drying, the Muir and Wager may be added as being among the best varieties.

PLANTING.

In preparing the ground for planting, it should be thoroughly free from stumps and roots, and plowed and subsoiled to a depth of sixteen inches or more, and no reasonable expense should be spared to have it perfectly pulverized. Planting in equilateral triangles is preferable to squares, as the ground is more completely occupied without the tops or roots of the trees intermingling. Fifteen per cent more trees can also be put on an acre by this method at same distances. The proper distance apart to place trees is now thought to be eighteen to twenty feet. Trees one year old are preferred.

PRUNING.

At the time of planting cut the tops from the trees to a uniform height of sixteen inches from the ground, and let from three to five of the branches growing at equal distances from each other form the top to the trees, and remove all other growth. Wrap the trees with paper below these branches to the ground as a protection from the sun and to keep out the borers. The following winter cut the branches back to six or eight inches long. The next year leave two or three shoots to each branch and cut them to a length of about twelve inches. When the tree is three years old, one third of the growth may be removed, but if a vigorous growth has been made one half may be cut away and thinning be done to keep the tree properly balanced, with the outer limbs standing at an angle of thirty degrees from a perpendicular. This will always enable plowing to be done close to the tree. After this, one third of the yearly growth is generally removed until the tree is six or seven years old, when the longest branches only are cut back, to keep the tree level on its top, and thinning sufficient to prevent the top from becoming too bushy.

FERTILIZING.

Quite heavy fertilizing can be made profitable. Stable manures are the least expensive when obtained near the orchard. An excellent fertilizer is two hundred pounds of bone dust, twenty-five pounds of potash, and twenty-five pounds of lime, placed in barrels or vats, the potash dissolved and poured over the bone dust, and lime then placed on top, and the mass well wet; then covered for ten days, and applied broadcast on an acre of orchard in the fall or winter, plowing or cultivating to immediately follow. This, if applied yearly, is said to furnish the necessary amount of phosphoric acid, nitrogen, lime, and potash to keep the soil in a peach orchard from becoming exhausted.

CULTIVATING.

It is usual to begin next to the trees, and plow with one horse three or four furrows on each side of the row to a depth of five or six inches; then with a larger plow and two horses the centers can be plowed to a depth of eight inches. This can be done in the early winter, care being taken not to work the ground when too wet. In February or March a second plowing can be made, this time turning the furrows in an opposite direction, which brings the ground back to its original level. Cultivation should immediately follow, before the soil becomes hardened by exposure to the sun and wind. This must be repeated after each succeeding rain, as soon as it becomes sufficiently dry; and after rains have ceased at intervals of two or three weeks, until the fruit is picked, when cultivation may be less frequent.

IRRIGATION.

Irrigation is usually begun in May, but it generally should be applied much earlier, sometimes in March and frequently in April, or whenever insufficient moisture is furnished by rainfall. It is well to plant the trees on a grade of about six inches fall to the rod. Ditches can be made with a single shovel plow, three feet apart, the rows of trees being the guide to the man making the furrows, and, with a little experience, he can always make them on that grade so that the water will run, while at less grade the work could not be done without surveying each furrow. Water should be run in the ditches until the ground is well saturated; then, as soon as it has become sufficiently dry, which takes from one to two days on light ground, but longer on heavier ground, it should be thoroughly cultivated to prevent baking, which, in most soils, is sure to occur unless cultivation follows each irrigation. Although this process is more expensive than the old method of running water in the same ditches through the entire season, the yield of fruit will be increased to an extent that will more than meet the extra expense. The fruit will be larger, and whether it is dried, canned, or sold fresh, the largest fruit sells for the highest price in the markets of the East.

PICKING AND PACKING.

Early peaches, such as the Alexander and Hale's Early, are only used when fresh, not being suited to either canning or drying, and all that can not be used in eating or cooking must be wasted. Nearly all the later varieties, when not sold fresh, can be either canned or dried. For distant shipment peaches must be quite firm when picked, although they should be colored and show signs of being in a ripe condition. It is at this time that their increase in size is most rapid, and, if picked too green, they will not only be small, but will never attain good eating qualities, and be miserable when reaching market.

The methods of picking and packing now in use can be improved upon. If the picker drops a peach into a box or basket, and the fall is only a few inches, it is thereby injured, although the injury may not be perceived by the most careful packer. It will, however, prematurely begin to decay at the very point struck when dropped. To avoid this, and all rough handling between the orchard and packing house, the fruit may be packed under the trees when it is desired to have very particular work done. A light handcart, with a frame under the axle arranged to take five or six peach boxes, and a platform above on which to wrap and pack the peaches, is needed for this work. The cart can be taken from tree to tree, each peach picked, and wrapped before leaving the hand and placed in the box. All overripe or imperfect fruit must be rejected. Even if it cost double to pack peaches by this method than in the usual way, it would be economy when they are to be sent to distant markets. Another plan is to line the boxes in which the fruit is to be placed from the tree with cotton batting, and cover this with old sacks or other cheap material, then insist that the picker carefully lay each peach in the box, and be never allowed to drop them even an inch from the hand. The peaches should never be emptied from the box, but taken to the packing house in a wagon, on which is placed a frame that will carry two or more tiers, that the boxes may never be placed one upon the other. The peaches should then be taken directly from this carrier, wrapped, and placed in the box for shipment. In hauling fruit from the field, or to the depot, spring wagons should be used, and care should be taken to have the roads as smooth as possible. An injury to a single peach is liable to cause premature decay, and thereby render worthless a box of otherwise good fruit when a market is reached.

CANNING AND DRYING.

In favored locations, peaches are sold fresh at prices that would not justify the grower to can them, and only the imperfect fruit is dried. Peaches to can should be extra large and nearly ripe enough to eat. The rest of the crop may be dried. The peaches of California are much larger than those grown to any considerable extent in any other part of the world, and they can be sold in unlimited quantities at good prices if only the large and perfect fruit is properly and carefully canned. There is more discrimination made by the consumer between large and small fruit when canned than dried, and for such they will pay a greater relative price, consequently there is more profit in canning the largest and drying the smallest. The details of both canning and drying may be left to those engaged in these special industries, as it requires skill that can only be obtained by practice. Very good dried fruit, however, can be made at the orchard by peeling the peaches, sulphuring at once, and drying them in the sun. This is practicable in orchards where peaches are sold fresh, and only a small portion of the crop is to be dried.

PEACHES A NEVER FAILING CROP.

There are sections in California where peaches have never failed to make a profitable crop during the last twenty years. The foothills of the Sierras are particularly adapted to the culture of this fruit, where a paying crop can always be relied upon.

PROFIT IN PEACHES.

It is not now necessary to deal in theories regarding the profits of peach culture. Statistics taken from the books of orchardists that are fully reliable, are here given in proof of this statement. The fruit from an orchard of eighty acres (mostly peaches) has this year sold for $10,000 cash. The total expense of producing and placing this fruit on the market was $4,000, leaving $6,000 net profit. Only about one fourth of this orchard is in full bearing, most of the trees being only four years old from dormant bud. With many years of experience as a fruit dealer and grower, the owner expects to realize, when this orchard comes into full bearing, much better average profits than he gets this season. Another orchard of thirty acres yields $5,000, more than half of which is net profit. Another of fifty acres gives the owner $8,000. These orchards are all in the same neighborhood, and are exceptional only that they are planted to fruit adapted to the section. The net profits of these orchards will pay interest at 6 per cent on more than $200,000, making the value of each acre $1,250, while the orchards are only in partial bearing.

CHERRY CULTURE.

Essay by James E. Gedney, Mesa Grande, San Diego County.

Being requested by a member of the State Board of Horticulture to give my views on cherry culture at Mesa Grande, this being about the only section of this county (San Diego) where cherries grow to perfection, I cheerfully submit the following hasty description, only regretting that pressure of business will not allow of my going more exhaustively into the subject. For better handling the subject I have arranged the headings in the following general order, each of which I will treat separately, viz.: "Climatic Conditions and Rainfall," "Soil," "Location and Exposure," "Varieties," "Time of Setting Out Trees," "Time of Flowering and Ripening of Fruit," etc.

CLIMATE.

During January, February, March, and April we experience heavy rainfalls, averaging, for the four months, twenty-three inches, with light falls of snow during February and March. Our May and June are warm, with light showers, averaging two inches for the two months. The months of July, August, September, and October are warm and dry, with the exception of occasional light thunder showers from the middle of July to the middle of August. The weather of November and December is changeable, with fine falls of rain, averaging, for the two months, five inches; making an average yearly rainfall of thirty inches. This has been my experience during the past seventeen years, all of which time I have resided in this locality. Mesa Grande lies fifty miles from the ocean, and has an average altitude of three thousand three hundred feet.

SOIL.

The soils of this section are of many classes, but that which claims our attention is that best adapted to the production of the cherry. I have experimented with the soil of the lowlands, second bench, and hillside or slopes, and find the hillsides or slopes best adapted to the cherry, especially those having a northern or western exposure. These hillsides are rocky, no outcropping of ledges, but loose rocks from the size of a walnut up to quite large bowlders abound. The soil, when wet, is of a dark iron color, and when dry, a dark gray color, and consists largely of mica, iron, and decomposed granite, with an underlayer of a reddish clay; is very easily worked, and not inclined to bake.

VARIETIES.

Among the most satisfactory varieties of cherries produced by me are the—

Governor Wood	Flowers April first and fruit ripens last of May.
Rockport	Flowers April first and fruit ripens June first.
Black Tartarian	Flowers April sixth and fruit ripens June twentieth.
Napoleon Bigarreau	Flowers April sixth and fruit ripens July first.
Centennial	Flowers April first and fruit ripens June fifteenth.
Late Duke	Flowers May first and fruit ripens August first.

I plant my trees about the middle of February, and find the best results by planting at this time. One reason for setting out the trees at this time is that the rains after this are not so dashing and heavy as to fill the newly made holes with water, thereby causing the soil in the newly filled holes to run together and settle in one solid ball, which bakes and becomes hard during the summer months. The rainfall is sufficient after this time to so settle the newly moved soil as to exclude the too free passage of air to the young rootlets, which, of course, is very necessary. I buy my trees from any good, reliable nursery, one year old from graft or bud, and before planting cut off all bruised roots. Better a root six inches long and perfect, than one three feet long and mutilated, because the mutilated roots only draw upon the healthy ones to assist in furnishing nourishment to heal their (the mutilated roots) wounds. At the time of planting I head back the young tree to about eighteen inches, thereby securing large, thrifty shoots below that point. This low heading I find very satisfactory, as the lower branches protect the body of the tree from the sun's heat, thus preventing sun scalds, gum sores, and sap souring. I plant my trees twenty feet apart each way. My method is to plant thus closely, and then keep my trees low by cutting back each year; this facilitates gathering the fruit very much. I prefer this way to setting the trees further apart and allowing them to attain too great a height. By the former method, I secure fully as good, if not better, results per acre, to say nothing of the difference in gathering the fruit. Another advantage in keeping the trees headed low is that the winds do not affect them nearly as much as it does tall trees.

PRUNING

I cut back in February two thirds the growth of the previous year. In this locality the cherry tree is inclined to grow large and very tall—say at four years twenty feet high. I cannot let them have Nature's way, or else all I could do would be to stand at the base of the trees and look up at the too inviting fruit, and wish I had been raised by irrigation that I might have grown correspondingly tall, so as to reach the topmost branches. I do not irrigate my trees, nor would I if I had oceans of water at my disposal. Irrigation only calls for triple cultivation, although portions of this coast will not produce without it.

CULTIVATION.

I plow my trees once a year about five inches deep. This I do about the first of April. The balance of the cultivation I do with an ordinary cultivator, and give the land shallow cultivation, generally three times during the months of April and May, and this ends the year's cultivation, unless the June rains should be sufficiently heavy to form a crust; if so, then I go over the ground once with a light, fine-toothed harrow, which breaks the crust and leaves the surface mellow. This amount of cultivation insures moisture near the surface during the fruiting season. I use great caution in cultivating not to bruise or bark the trees, as the cherry tree does not heal so readily as many other varieties of trees, but is more inclined to gum and create running sores.

MARKET.

My market thus far has been principally at the orchard; cherry culture being comparatively a new industry in this locality, the demand from the neighboring cities and towns more than equals the supply. Customers from far and near come, do their own picking, pay their 11 cents per pound, load them into their wagons in shallow boxes, and go off happy, having procured the rich, luscious fruit fresh from the trees, and as large and fine flavored as can be produced in any portion of the State. The varieties I have named stand transportation remarkably well. Packed in ten-pound boxes, placed in an ordinary ranch wagon, they arrive in good condition after a trip of sixty miles over rough mountain roads. The Napoleon Bigarreau, in particular, is a fine shipper, and I think it will stand more punishment, and for a longer period, and then come out in better condition, than all other varieties that I am familiar with. I would recommend the planting of this variety in all sections where it does as well as it does here, not only because it is a good shipper, but on account of its immense size and luscious flavor. The Black Tartarian, Governor Wood, and Rockport are standard varieties, too well known to need any comments from me. The Late Duke I consider a valuable variety, ripening, as it does, early in August, after all the varieties are gone, it, of course, commands a higher price. Its real value, however, is as a pie fruit, either canned or fresh, as it is a very acid cherry.

PESTS.

The only pests I have to contend with are the gopher and borer, both of which I keep pretty well under subjection. The former I make away with by shooting, trapping, etc., and the latter I protect the trees against until they are old enough to resist the attacks of the borer. I use a thick mixture containing, among other things, crude carbolic acid pretty well diluted, and this I apply to the young trees once a year, by rubbing up and down with my hand for the distance of a foot or more from the ground. This forms a thick coating, which the borer does not penetrate. When the tree gets three years old, it is old enough to resist the attacks of the borer.

PROFITS.

A word as to the profits of cherry growing with me. I have one hundred trees four years old from planting in orchard, making five years from bud or graft. These trees this year produced an average of fifty pounds per tree, which I sold at 11 cents per pound on the tree, making $5 50 per tree, and at the rate of one hundred trees per acre, a revenue of $550 per acre is realized and no expense of picking, packing, or transportation. My older trees of course yield more than double this amount. I feel that I am guaranteed these prices for years to come, as it is well known that but few localities in Southern California will produce the cherry in perfection, while the population is increasing very rapidly, and all the tenderfoots settling and making homes in Southern California bring with them their cherry tooth. They cannot all or any great portion of them make homes in the cherry belt, as that is limited.

This locality, Mesa Grande, is, up to this time, the only portion of San Diego County noted as a cherry-producing locality, while the county at large is not only capable, but does produce the greatest variety of fruits of any other county on the Pacific Coast, ranging from the orange and lemon on the coast, to the late winter apples and pears back in the mountains. But I am not penning this as an advertisement of the county, therefore pray excuse a deviation from the main subject.

To conclude with, I would recommend the propagation of the cherry in all sections that are adapted to its production, as it is one of the most profitable fruits in cultivation, and always finds a ready market. My cherry orchard consists of four hundred and fifty trees, about three hundred in bearing. The planting of the cherry is becoming more general at Mesa Grande now, and neighbors are setting out trees, and more are contemplating planting the coming season. I think the altitude cuts but little figure in the production of the cherry; it depends more on the quality of the soil and a sufficient annual rainfall, say an average of thirty inches per year. Plant upon well drained hillsides, no matter how rocky, providing it is not too rocky to cultivate. These rocks keep the soil loose, and the heat they gather through the day is thrown off at night, keeping the soil warm.

Give the trees no irrigation; at least that is true in Southern California, where the soils are too dry to produce without the application of water. All who have tried have failed to produce cherries with irrigation. The tree grows and flowers from three to five years, but never ripens fruit, and usually dies at the end of five years, or before.

DISCUSSION.

MR. A. T. HATCH, of Suisun: I have carefully observed the method of pruning in Mr. W. W. Smith's orchards, and also noted the results year after year. Of course, no two trees can be exactly alike, but a person traveling along the road adjoining his orchard could readily imagine they had all been trained out of the same mold, and yet many different men have done it at different times. One set of men trained them one year, and most likely the next year a new set of men were trained to do the pruning.

MR. GRAY: One word. I understood Mr. Butler to say that most orchardists now set out their trees from eighteen to twenty feet apart. I think that is a mistake, at least in this section of the country; it may do on poor soil, but if we want to go through the rows of our trees in this part of the country, we must put them at least twenty-five feet apart, and then we have to dodge around to get the fruit out. I think that that is a mistake that should not go out to the young fruit growers.

GENERAL CHIPMAN: There are two points presented in this discussion upon which I want to say a word. I am a young planter, and the nurserymen told me, in the catalogues, to plant twenty feet apart. I did not think they wanted to sell me twice the number of trees to the acre, and I don't think they did, but I made a grievous mistake. I have got one hundred and fifty acres of various fruits planted twenty feet apart, and I believe I would give $100 an acre if they were thirty feet apart; it is too late to remedy it, as I want to grow trees for wood and fruit both. Now, on the question of cutting back the first year, Mr. Butler says sixteen inches; I have spoiled part of my orchard by following the rule which was introduced here of cutting to the knee, which was about sixteen or eighteen inches. I think it is a mistake to have a tree branch out above twelve inches from the ground, and a very great mistake. It is made by young planters very persistently; it is made in that very fine orchard across the way. I passed trees to-day that had better been grubbed out four or five years ago, a mistake which ought not to have been made by intelligent orchardists in this State. There are trees there branching out on an average three feet from the ground. I think it is a very grievous mistake, and I want to emphasize it, as it has been brought forward here in the discussion, and to my mind, it is one of the fundamental mistakes. It begins in the first year, the very time you plant your trees. I have gone out to young orchards in my vicinity where the eastern man has come in with his old fashioned ideas of walking under the branches, and having his picnic under the apple trees, and I could not make him cut them down. The reasons are so obvious that it is hardly necessary to occupy the space of your record. To some eyes the body of the tree is protected from the scorching sun and the heat of the valley; second, the fruit is within reach; third, the system of pruning, which goes with that, enables you to keep your tree in a better shape; and fourth, you get more readily the moisture from the ground. You don't have so far to travel to get to your fruit, and in that way you have superior fruit. I want to emphasize this to the young planters who come from the East, in order that they may not be discouraged with fruit growing here, to see that they do not make this fundamental mistake of starting at eighteen or twenty inches from the ground.

Dr. Peck: I only want to say two or three words for those of us who live up on the foothills, on the granitic soil, and plant our peaches on the hillside. Take the advice of the valley growers, and you will make a terrible mistake, and if the valley farmers take our advice they will make a mistake. There is no comparison between our lands and your lands. Mr. Butler is absolutely correct; eighteen or twenty feet apart for peaches with us is far enough apart. We claim that we can produce good peaches, and we do grow good peaches, for they bring us a good price, and those who are cultivating peaches get rich, rich enough for common folks; and if they would plant their trees twenty-five, or thirty, or forty feet apart, they would waste their land; there would be no practical, good results.

Mr. W. W. Smith, of Vacaville: We prune our trees in the shape of a vase, or conical; a tree with a hollow center, that admits the sun into the center of the tree and throws your fruit on the outside, so that it all ripens up pretty much alike, and you can pick it without much trouble; there is but very little of the fruit grows in the shade. The sun and air in this country are essential to the full development of our fruit, especially the peach and the apricot. Plant a one year old tree from the bud or graft, a straight switch as they come from the nursery. After the tree is set out cut off about a foot from the ground. In setting your trees, in handling them, and in taking them from the nursery, always take care not to rub the buds off near the ground. After the tree is set out and after you prune it—the growth begins in the spring of the year—when the tender shoots begin to grow and are about the length of your finger, go through the orchard and pinch back the terminal bud of all branches that start, except three, four, or five. During the winter, after the first summer's growth, prune to about eight inches, leave them about square; then you have your straight stalk with three or more small branches, eight inches long at the top; that is your tree after it is pruned the second year; next summer let two branches grow on each one of those near the top. Be careful to cut to an outside bud if you want to spread your tree; if you want to draw your tree in cut to an inside bud; you can all see the reason for that. During the second summer, when your tree has four or five branches started, let two grow on each one of them, pinching back all below those; that is easy, quick work to do, and pick off the tender buds; let those remaining grow all they will, the more the better. During the next winter cut these back again to about fifteen inches; then you have formed your tree with a main branch, and your three branches, and your six branches. During the next winter cut those six branches back to fifteen inches, allowing each one to grow two branches again; if they put out more pinch them out; you can do it during the summer a great deal easier, economizing the growth, economizing the sap, and as you want it, not letting it all grow out and then throw it away. After this cut away about two thirds of last summer's growth during the winter, and when your tree is four years old and upwards, you will have altogether too much fruit on it if it is a peach, or an apricot, or a plum particularly—any of our pit fruits. The next thing is to thin the fruit; pull it off with your fingers when it is about the size of the end of your thumb. A practiced man will thin them very fast. The rule that I give my man is to let no two peaches, plums, or nectarines grow closer together than six inches on the same branch, and in the majority of cases the trees will then have too much fruit on them. I thin some of my peaches the third time.

WHEAT VS. FRUIT.

Essay by **General N. P. Chipman**, Red Bluff.

WHEAT GROWING IN CALIFORNIA.

I have been requested to submit some observations upon the issue of wheat vs. fruit.

In the sense that wheat growing and fruit growing are antagonistic, and that one or the other must cease in this State, I must decline to discuss the question. There can be no antagonism, and should be none between these great industries. Both are important, and both must continue. In the evolution of California, her second stage was the wheat era, during which, in one year at least, 1880, she stood foremost among the States of the Union, producing fifty-five million bushels; thus showing the marvelous resources of our soil, and our ability to lead in whatever we find adapted to both soil and climate.

The question I shall discuss is, whether we should continue wheat growing as our chief agricultural industry, or whether we should encourage and develop our fruit industry to the curtailment of our wheat area and wheat output.

Our soil is the prime source of our wealth, and should be so utilized as to yield its highest and best results.

Observation teaches and statistics show that constant and successive croppings of wheat impoverish the soil and diminish the average yield in direct ratio with the persistency and close succession of the croppings. This is shown in the comparatively recent virgin soils of Dakota and other western wheat regions.

President Stickney, of the Chicago, St. Paul, and Kansas City Railroad, recently stated at a meeting of the Chamber of Commerce of St. Paul, that the average wheat crop in northern Minnesota and Dakota had fallen to twelve bushels an acre, and was growing less every year. I quote from his reported speech: "Where the farmers of northern Minnesota produced twenty and twenty-five bushels a few years ago, they now only grow twelve. The expense of raising wheat is $8 per acre. When the yield falls much below twelve bushels the farmer will not receive his $1 for $1. I think it is time to sound the alarm to our farmers. The history of farming in Minnesota gives this: The first year's crop is good, and will perhaps pay for the farm. The second year is better, and the machinery is paid for. The third year is not so good, but buildings are erected. From that time the crops are poorer, and the farmer begins to run behind, and finally he mortgages and loses it. If he had only stopped at the end of the fourth year and changed his plans of farming, he would have been saved."

He then warns the merchants of the danger, and says: "Tell the farmers to change from wheat growing to something else. Drum it into them. We must force them to abandon their policy of wheat growing alone."

How long do you suppose a Minnesota farmer would go on raising wheat under such depressing conditions if he could plant raisins, grapes, and figs, and olives, and oranges, and apricots, and all our fruits and nuts? But I must not anticipate the case of the defendant.

Within one half mile from where we now are is a two hundred-acre field, being a part of the noble Rancho Chico. The field has been cropped to wheat for over thirty years. The land is of the richest and finest quality. General Bidwell has assured me that in early days it produced seventy bushels to the acre. The yield now rarely exceeds twenty-five.

Addressing gentlemen familiar with the law governing successive croppings of the soil to one kind of grain, I need spend no further time on this proposition.

In this State we mitigate somewhat the operation of this law by our system of summer fallowing, but this only prolongs the fertility of the soil; it does not restore it. The rapid exhaustion is somewhat arrested, but exhaustion goes on in less ratio.

So intelligent a wheat grower as Judge O. C. Pratt, I am told, claims that land not far south of Chico, grown to wheat on the summer fallow principle, shows no falling off in yield. I cannot dispute his observations. It may be that the occasional overflow from the Sacramento River and Butte Creek gives back to the soil the fertilizing properties exhausted by the process of wheat growth, as I think is the fact as to other lands around Durham and Biggs, of which the same claim is made of constant and undiminished fertility.

Of one thing, however, we may feel assured, that an inflexible law of nature is not to be ignored. The soil cannot be made to give up its properties without exhaustion, unless we return in some form an equivalent.

The census of 1880 showed that California had one million eight hundred and thirty-two thousand four hundred and twenty-nine acres in wheat, yielding twenty-nine million seventeen thousand seven hundred and seven bushels—an average of fifteen and eighty-three one hundredths bushels per acre.

The Agricultural Department at Washington reported February, 1888, that in 1887 California had two million seven hundred and sixty-six thousand two hundred and thirty-five acres in wheat, yielding thirty million four hundred and twenty-nine thousand bushels—an average of a trifle over eleven bushels per acre. The average per acre in 1886 was eleven and one third. This shows a falling off in the average of four and one half bushels per acre, or a little over 28 per cent, in eighteen years. It is a rather significant fact that our average has falling off much more than the average for the whole United States.

The annual average for the United States from 1870 to 1880 was twelve and four tenths bushels, and from 1880 to 1887 twelve and one tenth bushels, being a falling off of only about three tenths of a bushel. This, I think, must be due to the greater proportion of new wheat lands being opened up elsewhere than in California, and to the fact that crops are changed to other cereals in other wheat States.

The conclusion, therefore, seems inevitable that constant wheat cropping in California of the same lands is gradually reducing fertility and should cease, except in favored regions, and should be intermitted by planting of other crops in all cases, or the land reinforced by artificial fertilization.

Following in line with impoverishment of the soil comes falling off in average price paid for wheat.

The Agricultural Department at Washington, in report of 1888, gives a table of twelve wheat States, not including California, which shows the average price of wheat from 1875 to 1887 to have gone from $1 per bushel to 68 cents, farm value.

This farm value varies more than would be supposed. In Kentucky in 1875 it was $1 05; same year in Nebraska, 64 cents; in Michigan it was $1 15; in Iowa, 71 cents.

The average export value for twelve years is given, showing that it fell from $1 12, in 1875, to 89 cents in 1887.

Mr. McCarty, in his valuable "Statistician," gives a table showing average value per bushel in the United States, average yield per acre, and average value per acre from 1862 to 1887. In 1886 the price reached $2 19½ per bushel, and in 1884 as low as 64½ cents per bushel; and the lowest yield, in 1881, giving ten and two tenths bushels per acre. The highest value per acre was $23, in 1867, and the lowest $8 05, in 1885. The average in 1887 was as follows: Value per bushel, 68.1 cents; yield per acre, twelve and one tenth bushels; value per acre, $8 25.

The average value per acre of California's wheat crop of 1887 was $7 40. This was a very bad year, but in 1886 the average value per acre of our wheat crop was only $7 30, as shown by the same authority. Both these years prices were low; but the question for the wheat grower to consider is, can better results be expected in the future, when we know that the average yield per acre is falling off, and the price has been on the decline for some years? It is certain that the wheat growers of California, as a class, have lost money in late years. Individual instances and exceptional lands may be pointed out where profits are made, but any one familiar with the struggles of the mass of wheat farmers in this State knows that matters with them have been going from bad to worse.

I tried an important case four years ago, where it became necessary to show the cash rental value per acre per annum of the best Sacramento River bottom lands in Tehama County, and they are as good as can be found for wheat raising. Such witnesses as John Finnell, J. S. Cone, Hugh Mooney, and Herbert Kraft were called. Two of these are among the largest and most successful wheat growers in the State. The result of the testimony showed that $3 per acre per annum was all a renter could afford to pay. This yields only 10 per cent interest on $30 per acre for land that at the time was assessed at $50 per acre, and is now selling at $100 per acre. The tax on the land was $1 per acre, leaving but $2 to the owner. This is only 2 per cent per annum on the market value of the land.

It is due to wheat growers and to the State to say, however, that our average yield is less, because many lands have been cultivated to wheat that are not adapted to it, and that the average value per acre is reduced for the same cause. That many men are making money raising wheat, I know to be true. I am only seeking to point out the actual condition of the industry generally, and to suggest better and higher uses for much of our lands now devoted to wheat.

There is another important factor for the California wheat grower to consider—the market for his surplus; and this also involves the question of the competition he must meet in seeking the markets of the world.

For our surplus the home market, outside of California, is shut off by the great mountain ranges, and the long line of rail transportation to States of the Union having a deficiency.

The market for our surplus wheat is Liverpool. California farmers will ever be subjected to the changing conditions in Europe and to the fluctuations in the cost of transportation by sea. This last element is a menacing one. A table of rates from 1878 to 1888 shows a fluctuation ranging from 85 shillings ($21 25) per long ton in 1881 to 25 shillings ($4 25) per ton in 1887. No one can foresee or provide against this factor; and it comes to this, that the price of California's surplus is fixed in Liverpool, and the price in Liverpool is fixed in part by the ship owners, and the ship owners are governed in part by the demand on this coast for freights brought hither from abroad. The table of shipping rates for the period named is itself the best commentary that can be made upon the uncertainty that must always attend the fixing a value upon our wheat. The table is as follows, and is for April first of each year: 1878, 50 shillings; 1879, 45 shillings; 1880, 45 shillings; 1881, 85 shillings; 1882, 65 shillings; 1883, 35 shillings; 1884, 35 shillings; 1885, 36.3 shillings; 1886, 32.6 shillings; 1887, 22.6 shillings; 1888, 25 shillings.

Our isolated situation adds still more to the difficulty, because Liverpool fixes the price of our home market. Mr. Starr, at Port Costa, pays about the price in Liverpool, less freight to Liverpool, plus cost of carriage from the interior. General Bidwell, at Chico, pays the Liverpool price, less cost of carriage to Port Costa, and thence to Liverpool. And so we in California are raising wheat in direct competition with all the world. This is not so in the great country east of the Rocky Mountains. The home consumption is enormous. The great manufacturing centers in the East are large buyers, and never ship from East to West.

The change from East to West of wheat production is an interesting fact in agriculture, and deserves passing notice.

In 1849 the Atlantic Coast produced 51.4 per cent of all our wheat. The central belt, 43.3 per cent, and the trans-Mississippi only 5.3 per cent. Gradually this changed so that in 1884 the order stood thus: Atlantic Coast, 12.2 per cent; the central belt, 36.1 per cent, and the trans-Mississippi, 51.7 per cent. The great West went from 5 per cent to 51 per cent, and the Atlantic Coast from 51 per cent down to 12.

The increase in absolute quantities on the Atlantic Coast was slight, but west of the Mississippi it went from five million two hundred and eighty-eight thousand nine hundred and eight bushels in 1849 to two hundred and sixty-four million nine hundred and twenty-six thousand bushels in 1884.

Whence comes our competition? It comes from the wheat growers in our own country and from foreign lands.

Steamer rates from New York City to Liverpool, per ton, are	$1 80
Water rates from Chicago to New York, per ton, are	1 82
From Chicago to Liverpool	$3 62
The average rate from San Francisco to Liverpool for the past eleven years is, per ton, 43 shillings, equal to	$10 75
To this add interior freights, averaging, probably on the whole crop shipped, per ton	2 50
Total, California to Liverpool	$13 25

This shows that we start in the race for Liverpool with our eastern farmer at a great disadvantage—nearly 30 cents a bushel. Our present rates of freight are not much over half the average for eleven years, but even this makes the cost to us more than double the cost from Chicago.

Another competitor on this continent I think will be the provinces of Canada, along the line of her great continental railroad. I am informed that an immense area of wheat land, equal in productiveness to our Dakota lands, lies along that road. British enterprise and British determination to be independent of the world for food products, will soon be directed towards that region.

British India already is a large factor in wheat competition, although not yet so formidable as has been feared. It seems to me, however, that a people who work for a few cents a day, who plow with a stick, who thrash with a flail, and market dirt and seeds of weeds with the grain, and themselves live on rice and millet, and scarcely know the taste of wheat, and outnumber us four times, who can increase their exports from two hundred and sixty-nine thousand eight hundred and fifty-eight bushels in 1872 to twenty million two hundred and ninety-two thousand one hundred bushels in 1885, are not to be despised. How long it may take to overcome the prejudices of centuries that cling to these people it is hard to say; but when improved implements and methods are introduced and adopted, how long will it take British India to supply the deficiency in Great Britain? Six times her export of 1885 would fully supply Great Britain on the basis of her average purchases for the past fifteen years.

In the Argentine Republic of South America we have another and a formidable prospective competitor. She has an immense area of land suitable for wheat culture. European immigration is rapidly changing pastoral lands into arable culture. In 1887 it was estimated that in three years the increase of cereal crops was 23 per cent, of which twenty million bushels were wheat, half of which was available for transportation. Should immigration continue wheat culture will be rapidly extended. In the opinion of our Commissioner of Agriculture Great Britain can more easily supply her wants from this source than from India.

Many of you will remember the remarkable essay of Prince Krapotkin in the "Nineteenth Century," upon the future food supply of Great Britain. I cannot stop to quote him, but he showed that the United Kingdom might have food to export and feed thirty-seven million people if her present area were cultivated as land is on the average in Belgium. And so it would seem that Great Britain has it in her power to supply herself within the borders of the United Kingdom alone.

I need not extend the list of competitors. They are Russia, Australasia, Africa, and some other countries.

This question of markets of the world, about which the people have recently heard a great deal, is a serious one to the producer in the United States. Good and bad crops or increase or decrease of area seems not to figure very much. It often happens that the price has been high when the crop was large, and often the reverse, and sometimes short crops and low prices go together, as we know to our sorrow in California. The supply of the world regulates the price, and our crop figures only towards the aggregate. The United States produces more than one fifth of the wheat of the world. The country has furnished in grain and flour from 1872 to 1884 51.1 per cent of the world's deficiency. Russia averaged 13.6 per cent, and India 7.9 per cent.

California exports about 70 per cent of her crop, or about twenty-five million bushels, and this is about one fifth of all the wheat exported from the United States in years of largest demand.

We produce about one twelfth of the wheat of the United States, so that our excess of exports over other portions of the Union is very great. This is the disadvantage we labor under in being deprived of a home market.

Improved methods of harvesting have cheapened wheat growing to large growers (the combined harvester has done much), but they are not available to the small farmer. But however cheaply we may grow wheat, of what will it avail after we have lost our market?

But I must leave the case of the plaintiff. Let us sum up our conclusions:

First—It seems to me that wheat growing in California for the markets of the world is at least precarious.

Second—Average production to the acre is diminishing.

Third—Fertility of the soil is diminishing.

Fourth—We are at a disadvantage with our competitors by reason of their cheaper and better facilities for transportation.

Fifth—There is a strong probability that wheat areas in India and South America and in the Canadian provinces will be greatly extended, and the demand upon the United States will gradually decrease and finally cease.

Sixth—California must decrease her wheat area, and increase her population, and thus increase the home market. The law governing surplus manufactures must be applied to agricultural products. The home market that has placed us first among the nations of the globe in manufactures must be brought to bear in agriculture. We must not be obliged to haul our products half way round the globe, past the doors of our most formidable competitors, in order to find a market. Of all the agricultural products of the United States, including cotton and tobacco, only 10 per cent are marketed abroad. Excluding cotton and tobacco, only 5 per cent, and yet we in California must go abroad in search of a market for 70 per cent of all our wheat. If we controlled the world's market in wheat, as the South does in cotton, this disproportion would be to our advantage, but unhappily this is not true, and in my belief the situation will not improve. I am prepared to see Great Britain supplied from other sources within the next ten years.

Seventh—Lands no longer profitable for fruit growing should be turned over to grasses and forage plants, or should be planted to fruits.

FRUIT GROWING IN CALIFORNIA.

I turn now to the case of the defendant.

In what way will our fruit industries mend matters? Shall we grow more fruit and less wheat? What are our advantages over other States of the Union, and what are these advantages intrinsically? I approach the discussion without misgivings and with great confidence.

The one thing above all others that gives preëminence to California as a fruit-growing State is its climate, the economic value of which is only just beginning to be realized.

There is a difference of only eight or ten degrees between the mean annual temperature of the coldest regions of Dakota and Minnesota, and San Francisco, yet in Minnesota and Dakota wheat flourishes with a minimum temperature of 60 or 70 degrees lower than we ever see it. It is the minimum and maximum that must control. Let us cease talking about the mean annual temperature. The mean in San Francisco is 55 degrees; the same as Washington City, where I have seen weeks of continuous zero weather. The mean of New York City is 54 degrees, only one degree lower than in San Francisco, and yet strong men froze to death there in the streets last winter, and snow completely stopped the arteries of commerce for nearly a week.

In this hall I see ripe oranges from Tehama County, grown in sight of the everlasting snows of Mount Shasta. The phenomenal cold of last winter, registering as low as 19 degrees above zero at the United States Signal Station at Red Bluff, did not destroy our orange trees, for they send here their defiance of the elements in the shape of ripe fruit from the same branches that were covered with ice and snow for a short time last January. It must not be forgotten that when we had 19 degrees above zero, a low temperature seldom reached, Dakota, Minnesota, and other Western and Northwestern States registered 40, and even 60 degrees below zero. Domestic animals froze to death in their tracks. Children perished on their way from school. Strong men died in the effort to reach their barns, and in sight of their homes. Forest trees as well as fruit trees were burned to death as by fire in this awful weather. It is not possible to overestimate the value of a country like ours to the fruit grower, in comparison with the frozen regions in the States east of the Rocky Mountains.

If the property of General Bidwell, with its climate, soil, capabilities, and surroundings, its orchards, flowers, and fruits, could be set down within one hundred and fifty miles of Chicago, it would sell for as much as the entire taxable value of Butte County. It is not the richness of the soil that would make this true, for equally rich soil is to be found in the State of Illinois, but it is the climate and its possibilities.

What would Riverside as we know it, or Vaca Valley as it is, be worth if situated in New York State? And may we not seek to realize the true value of our great advantages by this comparison.

When I read last winter, how that athlete and intellectual giant, Roscoe Conkling, fought for his life and lost it in a struggle to reach the Fifth Avenue Hotel, across Union Square; when I read the pathetic story of that heroic school mistress who toiled through the deadly western blizzard in a vain endeavor to save the children committed to her charge, it seemed to me that the transcontinental railroads would not be able to transport the people who would fly to this land of sunshine and plenty; and I still believe that our climate, which alone makes our State proudly distinctive among the States of the Union, will bring us the population of the East and the Great West as rapidly as we can prepare for them, and as soon as they can dispose of their property there.

But the question recurs: Is fruit growing profitable? Can we afford to surrender some, not all, of our wheat lands to its culture? As yet we have not that kind and amount of data to enable us, from observations through a period of years, to deduce results entirely satisfactory. Fruit growing in California is but in its infancy. Some facts, however, and important ones, are established.

The era of fruit growing has greatly enhanced values of land; and this enhancement is being steadily maintained and augmented. Many a wheat mortgage has been lifted by the fruit grower. In the absence of general statistics showing the results or profits of fruit growing in this State, we can only look to typical regions where these are now well known. Take Vaca Valley as a type of the northern portion of the State: Prior to 1874 that valley was devoted to wheat growing. It cut no figure in trade, and the owners of land were making but little money, comparatively, and the lands had no value except for wheat growing, and the price was low. Fruit planting began about that time, and now nearly the entire valley is in trees—about four thousand five hundred acres. Mr. W. W. Smith has an orchard of two hundred acres there, which I am informed yields a net income of from $100 to $200 an acre annually. In 1874 this land was valued at $12,000. It is now worth $600 an acre, and I do not suppose could be bought for that; indeed, Mr. Smith was offered $1,000 per acre for one hundred acres recently. A recent purchase of nine hundred acres, lying just outside this valley, was made for $100,000. Subsequently, at an auction sale, one half sold for nearly enough to pay for the whole. I have been reliably informed that there was paid to fruit growers last year in this valley, through the Vacaville Bank, $900,000; and this is $200 per acre for all the fruit lands of the valley by the way of income. These are all non-irrigated orchards, and fruit growing there is certainly in a most healthy and prosperous condition. Similar conditions of success and prosperity exist in the Santa Clara Valley, around Woodland, Sacramento, Marysville, Newcastle, and a score more of places.

Fresno County furnishes an illustration of the revolution worked by fruit growing. Here irrigation is essential. I think the change from wheat to fruit in Fresno County does not date back of 1880, and yet her raisins are known and eaten by all men. Lands formerly selling from $5 to $10 per acre, now sell into the hundreds, and pay good interest on the investments. It is situated in the central region or southern San Joaquin Valley.

Riverside furnishes an example of the magical change wrought by water and fruit culture. Lands here classed as desert and practically valueless three years ago, pay interest at $500 to $1,000 per acre. This is Southern California.

Another type is found around Newcastle, in the foothill region of Placer County.

The development here is marvelous and gives great hope of all the foothill lands, of which there are millions of unoccupied acres in this State purchasable at low prices.

Lands around Newcastle selling five years ago at $5 to $10 per acre, now bring $100 and over per acre. The elevation is from five hundred to one thousand feet above sea level. Olives, figs, oranges, and all deciduous fruits flourish here. Planters are prosperous and making money. Irrigation is practiced although not always necessary.

These are communities of intelligent and capable growers who know the art of growing and marketing fruit.

This enhancement of value is felt throughout the entire State, as is shown beyond dispute by the enormous increase of the taxable value of lands lying within the fruit belt.

I find great difficulty in dealing with the question of the profitableness of fruit growing in California, for lack of general statistics. I can give well authenticated instances of fruit growing on a large and small scale in all parts of the State, showing very large profits on the investment at the very high prices of land, or cost of an orchard brought to the bearing point. I hesitate to do this, however, because no one should generalize from such insufficient data. I think, however, it is within the observation of every intelligent fruit grower in this State that, where the business is pursued with that intelligence which its nature and character demand, no more lucrative or profitable business can be engaged in by tillers of the soil.

Intelligent fruit growing implies a knowledge of soil, climatic influences, varieties to plant, the art of culture and handling, and business tact to market the product.

Aside from any particular illustration showing the profitableness of fruit growing, we have, what to my mind is an exceedingly strong argument in that direction, viz.: In all the valley counties, from Shasta to San Diego, men of business shrewdness and intelligent observation, who have been long residents of the State, and have observed our fruit development, are buying lands for fruit growing, and paying prices far beyond any price that would yield an income in wheat growing or for any other purpose than for fruit.

Probably the best single illustration covering the widest territory, and the greatest variety of fruit, is shown in the result of the work of the California Fruit Union for the year 1887. I take this from the "California Fruit Grower," of November 10, 1888:

Boxes shipped		328,296
Crates shipped		169,268
Net weight of fruit, not including weight of package (pounds)		11,363,020
Gross receipts		$675,864 40
Freight paid	$283,033 80	
Cartage paid	6,002 35	
Commissions paid	67,254 40	
Gross charges		356,289 55
Total net returns		$319,574 85

This shows the net average per pound realized to the grower in this State to be 2.8 cents. If we knew precisely what to deduct as the cost of production, boxing, and delivering to the Union, we would know what this green fruit yielded per pound as net profit to the grower. In 1886 the net profit to the grower through the Union was 2.41 cents per pound, and for 1887 it is estimated at about 2.25 cents per pound net to the grower. By strong support of this Union, and by gradual increase of shipments, the cost of sale will be reduced materially, which will add to net result.

Trees in full bearing will average one hundred and fifty pounds each, or fifteen thousand to the acre. This fruit at Union rates for 1887 would yield net $420 per acre. Pruning, cultivating, thinning, picking, boxing, and delivering to the Union, I cannot figure beyond $120 per acre, leaving balance net over all to grower $300.

As an orchardist myself, looking forward to the time when my investment will yield me a steady and fair income, I promise myself, as I promise others, that $100 per acre as a net return is good enough, and can, in my opinion, be safely relied upon, always presupposing the best and most intelligent cultivation, handling, and marketing.

The constancy of our fruit crop, and the early yield, and the early fruitage of new orchards, and the long life of our trees, are all well understood, and are advantages which we enjoy over any other region of the United States. That we can raise fruit in large quantities, and of exceptional quality, no longer admits of a doubt. The kinds of fruit we grow greatly strengthen our case. In no State of this Union, and in no country in all Europe or elsewhere, of which I have any knowledge, is so great a range of fruit produced as in California. Oranges, olives, lemons, limes, plums, prunes, figs, grapes, and nuts of all kinds, apricots, peaches, nectarines, pears, cherries, apples, all the small fruits; indeed, every fruit known to commerce, save only a few exclusively tropical fruits not much known to us, are here produced. All varieties of all zones seem to flourish here, regardless of characteristics in their native habitat. These are prodigious advantages; they are beyond computation in money value; they come of our climate, our ocean and mountain influences, and our soil.

Our best wheat lands produce from one half to two thirds of a ton of marketable wheat per acre. In fruit, these same lands will produce from five to fifteen tons of green fruit to the acre. Looking towards the market for wheat and fruit as it now exists, I believe that fruit will yield more net profit per pound to the grower than wheat.

There being no longer any dispute about our raising almost all known fruits of the earth in large quantities, the great question, as in wheat growing, is the market.

Here, as in other departments of investigation on this subject, we lack data. The country imported in the year 1886–7 of fruits and nuts $20,608,480. I am not able to inform you whence all these fruits came, or what kinds of fruits they were. It may be stated generally, however, that they were chiefly the fruits and nuts grown in our California orchards. We have, then, this field for operations. As showing increased consumption, the imports of fruits for 1887 exceeded imports for 1886 by over $3,000,000.

A tentative estimate of the Commissioner of Agriculture, report 1888, of the products of agriculture, 1886, gives the farm value of the fruits of the United States to be $175,000,000.

This is equal to one half of the dairy products of the country; is more that half our wheat crop; more than one fourth of the corn crop; is more than double the oat crop; is more than double the wool crop; is about equal to the wool, hemp, flax, tobacco, hops, sugar, syrup, honey, grass seeds, and wines combined, and is nearly the value of all the vegetables grown.

We export only about $1,000,000 in value. The consumption of fruit is about $3 per annum per capita on our Commissioner's estimate of production.

If we could double the present consumption of fruit in this country it would give California an income beyond what we now have of over $150,000,000, allowing the East and Oregon to take the balance, and it seems not an extravagant hope that this increase will be attained.

Our population is growing at the rate of nearly or quite three fourths of a million people annually. Demand for the fruits of the earth goes on with increased number of mouths to feed.

Notwithstanding the importance of fruit culture to this country, there has been no organized effort to aid it through our Agricultural Department at Washington, until 1886. Mr. H. E. VanDeman in his second annual report to the Commissioner of Agriculture (report 1888) says: "The year 1887 may really be said to be the first in which I have had an opportunity to get the machinery of this division (Division of Pomology) in good working order."

This great Government, with more money than it knew what to do with, started this division with an appropriation of $3,000 in 1886–7, and repeated this munificent provision for 1887–8.

One man was detailed in 1886 to serve the cause of practical and scientific pomology for the United States. In 1887 the force consisted of a clerk, and an artist occasionally, to make the few drawings found in the report, and with this paltry $3,000 all the expenses of the division are borne, including the salaries of the clerk and artist. Mr. VanDeman speaks of several valuable papers that have been prepared, gratuitously, I suppose, all of which await appropriations before they can be given to the world. It is to be hoped that these valuable papers, and the matter they contain, will not have fallen into innocuous desuetude before Congress awakens to their importance.

I want to digress a moment to record in the most public manner my utter disrespect for the statesmanship that has been one hundred years in realizing that agriculture was of sufficient importance to entitle it to a Department of Government. In 1880 our census showed our agricultural products to be of the value of $3,020,000,000; nearly $500,000,000 more than Russia produced with her one hundred million population; nearly $800,000,000 more than imperial Germany, and more than Austria, Italy, Spain, Australia, and Canada combined.

To-day our agricultural products amount to two thirds of all the products of the United States. They have made our nation great and powerful and independent. There is no food product, except possibly rice and sugar, of which we do not produce a surplus, and of these there need be no deficiency.

No victory of peace or of war in all history is comparable to this. A hundred years ago agriculture stood stationary where it had stood for a thousand years before. The farmers of America have rescued agriculture and given to the soil a new value; they have simplified the problem of government by bringing abundance where poverty and want taxed the resources of statesmanship.

In all these years the American farmer has gone on unaided save by the inspiration of his love of home and country and made this nation great and powerful.

France, with one twelfth our area and not much over half our population, appropriates $20,000,000 annually to foster agriculture. Brazil, with thirteen million population, appropriates $12,000,000 for this purpose annually. The United States, with a larger area and ten million more population than both these countries, appropriates less than half a million dollars in aid of agriculture.

Let us hope that the new Department of Agriculture will be liberally supported and wisely administered, and that the Division of Pomology will not be overlooked.

To illustrate the increased consumption of fruits, and this bears directly on the question of market, I give a table showing imports for three decades of oranges and lemons:

1856–57	447,136 boxes of oranges	238,297 boxes of lemons.
1866–67	692,259 boxes of oranges	337,441 boxes of lemons.
1876–77	893,820 boxes of oranges	612,463 boxes of lemons.
1886–87	1,741,644 boxes of oranges	2,281,087 boxes of lemons.

Imports of oranges have doubled in ten years, notwithstanding the large shipments going forward each year from California and from Florida.

We imported, for the year 1886–87, forty million six hundred and sixty thousand six hundred and three pounds of raisins—over two million twenty-pound boxes—and we produced last year and sold about eight hundred thousand boxes. There is no reason why we should not have the entire raisin trade of this country, and push our goods into foreign lands. Already four thousand boxes have gone to London on an order for this year's crop.

We imported, same year, eight million seven hundred and fifty-two thousand eight hundred and ninety-eight pounds of figs. No doubt is entertained by any one that fig growing in California is very remunerative. Prices are quoted at 5½ to 10 cents. At 6 cents a pound the figs imported would show a value of $525,173.

From the single port of Bordeaux we imported of prunes in 1886 of value of $840,299 19, as shown by report of our Consulate.

We excel in our prunes, and eventually we must have the market. I have no means of knowing our production, but it is quite large, and is increasing.

I have spoken of the faith in fruit shown by the investments in lands at high prices, and the extensive planting going on by our most intelligent and sagacious people all over the State. Let me further emphasize this point by showing comparative results:

In 1871 there were less than two million pounds of green fruit shipped overland; in 1887 we shipped forty-nine million seven hundred and twenty-nine thousand eight hundred pounds.

Of canned fruits we shipped, in 1872, one hundred and eighty-two thousand pounds; in 1887 we shipped forty-five million one hundred and twenty thousand nine hundred pounds.

Of dried fruits we shipped, in 1875, a little over five hundred thousand pounds; and in 1887, thirteen million five hundred and seventy-seven thousand one hundred pounds.

Of raisins we shipped, in 1874, only two hundred and twenty pounds; in 1885, we shipped six million two hundred thousand pounds, and much more in later years. Our pack this year is estimated at nine hundred thousand boxes, or eighteen million pounds.

Notwithstanding this rapid increase and this very large shipment of green fruits, we have as yet scarcely given the mass of the people living east of the Rocky Mountains a taste of our fruits.

In a very interesting and deeply instructive report recently made by Mr. W. H. Mills to the State Board of Trade, showing the result of the Grand Army exhibition at Columbus, Ohio, this summer, some significant facts are given, bearing directly upon the question of market.

I quote: "Parties from southern Nebraska assured me that no California fruit had ever been offered in their vicinity, notwithstanding they are residing upon lines of railroads. Parties in Kansas gave the same assurances; the same testimony came from Illinois, Indiana, Ohio, Pennsylvania, and Michigan." Mr. Mills then points out how our fruit is massed in Chicago, and sold out at prices making it a luxury and depriving it of all value as food, and suggests a remedy. He continues: "In this way the fruits in their various seasons could be distributed to a population of from twenty million to thirty-five million people. We can place all kinds of fruits in eastern markets from two to three months earlier than they ripen in any part of the country north of Tennessee, North Carolina, and Arkansas. In this general region there are over forty millions of people, a very large proportion of whom would become consumers could the fruit be furnished to them at anything like an economic rate." He says he found grapes selling in Chicago at $200 per ton at retail, thus depriving people in the middle and lower circumstances of life the privilege of even tasting them, and yet the freight charged against the grapes in that market is only $50 per ton.

If Mr. Mills' observations are sound, and they are corroborated by the highest evidence, this market is very large. It is difficult to give an adequate idea of its extent. Large as our shipments seem now, if each day we could reach the eastern people our present yearly shipment would hardly supply the daily demand for green fruits.

When we come to our prepared fruits—dried, canned, preserved, and crystallized—and our nuts, and our olive oil, and other prepared products, we have the world's markets. Our raisins and prunes have already pushed their way abroad, and our canned goods Mr. Lubin has described as obtainable in Crosse & Blackwell's great fruit house in London.

I have the greatest confidence in our superior ability to improve upon methods, ultimately conducting us in California to the front rank in fruit growing, as it has in almost every branch of agriculture and manufacture in the United States.

There will come a day when people who can have clean fruit, will cease buying imported prunes that are handled by dirty peasants and finally trampled into barrels and kegs with the bare feet; and so with currants.

There are some considerations as to our eastern market not readily assented to, and yet are beyond dispute. As a general fruit-growing country, the great west and northwest region, indeed, the Middle and New England States, are failures. The history of tree planting is the history of discouragement and disaster.

I am a member of the American Horticultural Society, formerly called Mississippi Valley Horticultural Society, and have read the four volumes of their proceedings with some care. Let me quote a specimen of troubles presented and remedies suggested.

Mr. J. S. Beatty, of Kentucky, in volume 2, page 219, reviews the peach interests in the central States of the Mississippi Valley. I quote: "The Mississippi Valley is more exposed to meteorological extremes and disturbances than any other part of this continent. The torrid heat of our summers and the arctic blizzards of our winters embrace a range of temperature from about 120 degrees in the shade to 40 degrees below zero. We are exposed to droughts and floods of great extremes." He gives a vivid description of the dread cyclone, and asks: "What is it that will hold out against these mighty forces? The trees cannot long endure the compound forces of old Sol, nor can the fruit germs resist the intense cold of 40 degrees below zero, or 20, or even 10 degrees, under certain conditions." He then describes the effect of protracted droughts, and says the fruit "wilts as passed through an evaporator." He proceeds to point out numerous other causes of failure. He concludes by asking five pertinent questions. I quote the fifth—says the writer: "Is there any practical way of protecting our peach trees by baling or thatching, to prevent winter killing of both trees and fruit? Also, could not late spring frosts be rendered harmless to peaches by means of a cheap iron furnace to burn coal in, set between every four trees, and fired up at any time that frosts may be expected?"

Imagine Mr. A. T. Hatch, of Suisun, with his orchard of six hundred acres, putting stoves in each square of four trees—twenty-five stoves to the acre—fifteen thousand stoves to fire up and keep going!

In the same volume, page 103, Professor Budd, of Iowa, says of pears: "We have not one ironclad." In California we don't know what fruit men are talking about when they speak of "ironclads." Fruit men East are searching out varieties grown as near the north pole as possible, in the hope of finding genuine "ironclads."

In volume 3, page 115, is a paper on "Success and Failure," submitted by Mr. George J. Kellogg, of Wisconsin. It is one wail of failure, with little ray of success to relieve the picture. I cannot ask you to bear much longer with me, but as a specimen let me quote what he says about cherries: "About every third year we raise nearly enough for the 'dear little birds.' The three varieties they like best are the Early Richmond, Red English, and Late English Morello. These give a succession to other fruits, and no doubt save the life of many a songster. Therefore, cherries are both a success and a failure."

I think Mr. Kellogg's philosophy, in the face of disaster, must have been reinforced by gazing on shipments from California of Mr. Leonard Coates' Centennial, or General Bidwell's Napoleon Bigarreau cherries, laid down firm and sweet, at reasonable prices, at Mr. Kellogg's door.

The apple is largely grown, when not a failure from some seasonal disaster, in Ohio, Indiana, Michigan, Illinois, and most of the New England States. In Minnesota, Iowa, Wisconsin, Dakota, and northern Nebraska, even the apple is almost despaired of, says Mr. VanDeman, owing to the ruinous effects of the severe winters. But we do not compete in apples.

The peach grows in a few States, and when they have a good crop, our market is affected as to dried fruit somewhat; but we are earlier in the market with our green fruits, and besides the maximum peach crop of the

East can never supply the increasing demand. In 1887 there was almost a total failure.

The plum is grown East to a limited extent only. The curculio is a universal and deadly pest. Besides, the foreign varieties common here are not grown there, and prunes as we know them are unknown there.

Some pears are grown, but are not in our way in any manner whatever.

A few varieties of excellent table grapes are grown, but our foreign varieties are unknown, except as we send them.

To my mind, eastern competition in fruit grown there is not a serious factor in our problem, and so long as the enlightened policy of Government protection to home products is pursued, we have nothing to fear from foreign countries.

The long list of fruits peculiar to this State will not grow shorter, but will be increased. We will raise dates, and possibly bananas. We will cease importing currants from Greece, and supply them in California.

In this discussion, I have not dealt with grapes for wine, and yet all intelligent observers predict great results from that industry. We are making large quantities of wines of great excellence, and choice grape brandy. Probably one hundred and fifty thousand acres are already in wine grapes.

The wine imports of the country are valued at port of shipment at $7,056,085. Import values give the minimum value, and often are fraudulently valued.

The true value of most foreign importations is much greater than the invoice value at port of shipment.

I have thus presented the case submitted to me. I am conscious of the imperfect manner in which I have dealt with our wheat and fruit industries.

If I had been allowed, without wandering from the question, I would have shown the wheat grower how much better it would be if he devoted some of his land to alfalfa and other grasses or forage plants, if he don't like fruit. He will smile when I tell him that the hay crop of the United States in 1886 was valued at nearly $40,000,000 more than the wheat crop; that even in California our hay crop was valued in 1886 at nearly half the value of our wheat. With the exception of corn, hay is the most valuable agricultural crop grown in the United States, and the average value per acre is greater than that of wheat. Corn is king, and hay is heir apparent to the throne in the United States, unless our fruits overtake and pass them both.

To the fruit grower I would like to have given some sound, fatherly advice, born of experience, but no doubt this will be supplied before we adjourn, and by more competent persons. I leave the question in your hands.

On motion of Professor Husmann, the thanks of the Convention were tendered to General Chipman for his able essay.

SHALL WE CAN OR DRY OUR FRUITS?

Essay by R. C. Kells, Yuba City.

I am sure all present not only feel a greater interest in fruit culture generally than ever before. After years of thought and labor the question arises, "What shall we do with the vast amount of fruit now growing and which will be produced in the near future throughout this great State? Where shall we look for consumers of our fruits, and after finding consumers, how shall we prepare our fruits for them?"

We will for a moment see what the consumers have done for us in the way of canned and dried fruits in 1887. As near as we can get at it there was used in this State in 1887, of fresh fruit for canning about sixteen thousand tons; there was used for drying (outside of raisins) about twenty thousand tons. We see by these figures that there was four thousand tons more green fruit used for drying than was used in canning. The same year our canners put up not only enough fruit to supply home and eastern markets, but had a surplus with which to fill large orders from Europe; thus showing that the sixteen thousand tons of fresh fruit canned about fills the demand of California canned fruits. There was consumed in the United States about two hundred million pounds of dried fruit, of which California only furnished twenty-six million pounds, the balance, some one hundred and seventy-four million pounds, was supplied by foreign countries, in about the proportion of one eighth of California production to seven eighths of the foreign. These two hundred million pounds of dried fruits include all dried fruits, raisins, prunes, etc.; thus showing that California must make seven times as much more dried fruits than she now does before we can think of supplying the market, which requires one hundred and forty thousand tons of green fruit, outside of raisins.

For one I do not see how we can expect to find markets for seven times as much more canned fruits than we now put up; but on the part of dried fruits we surely have an unlimited market.

As I said in the beginning, who or where are the customers for this fruit? They are the people east of the Rockies.

Another question arises: "Why is there a greater demand for our dried than for our canned fruits?" Our customers say that our canned fruits cannot be excelled, nor can any other canned fruits throughout the world be compared with ours. The answer is: "We cannot afford, as a people, to buy and eat your canned fruits, but we are able to buy some of your dried fruits." It stands us in hand, as fruit growers, to do something toward getting our dried and canned fruits into the mouths of the eastern consumers. The question has resolved itself into a matter of dollars and cents, as it is claimed that it is not the quality of our fruits, but the price, that prevents a greater use of it. We hear more complaint about our dried fruits than the canned, which is the result of too much carelessness on the part of the average fruit grower in preparing his dried fruit for market. The cost of selling a pound of poor fruit is greater than that of good, while the freight is the same; at the same time losing our reputation as growers and packers. Let us, when drying our fruit, do away with the Grecian or Spanish system, as well as the so called "Chinee" system of swindling our eastern customers with so much filth and dirt, while with a trifling cost more we can supply all the markets with good, clean, and wholesome fruit, whereby we will find ready sales at living prices; and our eastern friends will say to the Turkish prune, the Spanish raisin, and the Grecian currant importers: "Thank you, we are done buying dirt and trash; we will try, for a change, the California prunes, raisins, currants, peaches, plums, nectarines, etc., and take less chance of contracting some loathsome disease."

Now, Mr. President, I have no doubt, when I finish reading this poorly constructed essay, that I will be classed as an advocate of fruit drying exclusively; and yet, while I am directly interested in fruit canning, I feel that fruit drying needs our most careful attention, as all growers are driers, more or less, while canning is conducted by a few individuals, and fruit canners have studied and learned the wants of their consumers; hence the reputation of California canned fruits. Why not make for our dried fruits as great a reputation? First, by making a good article, placing it on the market, avoiding the usual two or three commission merchants, as in the past; second, by asking railroad companies to give us living freight rates. There being no question as to our having fruit of the very best quality, and in great quantities, the question is: "Shall we can or dry our fruits?" My answer is: "The time is not far distant when the drying of our California fruits will be first on the list; for as sure as our eastern friends find that they can get our dried fruits in quantity, at living prices, the result will be they will eat less pork and cabbage and more fruit and fritters."

Mr. W. W. Smith, of Vacaville: The ladies might just as well undertake to make a silk dress out of a bolt of calico as to make good dried fruit out of poor, immature fruit. Let your fruit stay on the trees until it is thoroughly ripe; pick carefully; don't shake it off on the ground, but pick it from the tree carefully in baskets, and haul it to your cutting shed; not on a common, stiff farm wagon, for if you do, you will have it badly bruised by the time you get to the shed, and every bruised spot in the green fruit shows a dark spot in the dried fruit. Haul it in a spring wagon. The fruit is cut, laid on trays, and immediately put in the sulphur box and sulphured for about forty minutes—an hour is better for a good dried article. There may be, and probably is, an objection in the minds of a great many people to this thing of sulphuring—fruit bleaching, as some call it. It does not bleach the fruit; it simply closes the pores and prevents the fruit from turning dark, and stops it from coloring; the fruit is already bright when it is cut. The trays are taken from the sulphur box to the drying grounds prepared for the purpose. A hillside sloping to the south to about 35 or 40 degrees is best.. The fruit dries quicker, and the quicker you can dry the fruit the better it is. Apricots dry in about three days from the time they are cut and put out in the sun, and are then taken up ready to box. Use boxes made of sugar pine dressed on both sides, that hold twenty-five pounds. With a common lever press or screw press you can easily press twenty-five pounds of dried peaches, apricots, or plums, into a box—size, six inches deep, nine inches wide, and sixteen inches long, holding twenty-five pounds. Let the fruit get thoroughly dry, as dry as a chip if you wish, and when you get ready to box dip it into boiling water. (By dipping you have got the pure fruit without any doctoring.) The dipping is to destroy the eggs of the insect that makes the worm in dried fruit, and if there are any insects that will kill them. Use a wire basket made of coarse wire, with meshes small enough so that the dried fruit will not drop out, but allows the water to pass through freely. Sink the basket into the boiling water, merely let it stay long enough for the water to permeate all through the basket, raise it out, dip it down again, and let it stay in about the same time; raise it out and let the water drip out, then lay the fruit in a pile on a table or a clean floor. Dip in that way what you can box the next day. Throw in a pile in order to let the whole mass become damp or dry alike; in this way the pile becomes equally damp. Let it remain until it gets pretty dry—so dry that there is no danger of molding after the fruit is pressed into the box. Line the boxes with fine oiled paper. Take some of the best specimens of fruit and spread them out with the fingers (a lady suggests running them through an ordinary clothes wringer), and place them in a layer in the bottom of the box; fill up the box; set it on the scales and weigh exactly twenty-five pounds of fruit into the box; take it out and put it under a press—a lever press is much more speedy than a screw press, and does the work equally well. When the press is put on the fruit and it is packed into the box enough to put the lid on, slip it out and nail the lid on and turn the box, and when it is opened to the market this faced box is shown, the same way as in packing cherries. Sometimes we put it into fifty-pound boxes instead of twenty-five.

A Delegate: When you put green fruit on trays do you turn it?

Mr. Smith: Put it on trays with the cup side up and dry it—no need of turning it. We prefer clingstone peaches to the freestone peach for drying. We have a knife that we can cut clingstone peaches as fast as we can freestone. So far as my experience goes, there is no advantage to dip into glycerine; it adds to the looks of the fruit, but it does not add anything to its value whatever for food, but it makes the fruit look and sell better. The object of dipping the prunes into boiling water or lye is simply to wrinkle or break the skin and hasten the drying process; this is before drying, immediately after taking it from the tree; dipping any of our dried fruits in boiling water or lye, as some do, of course restores a great deal of moisture to the dried fruit, and I will give you a pointer that may be worth something to you: the dried fruit will take up moisture enough to pay all the expenses of boxing your fruit, and nobody is injured by it, because the fruit itself is benefited. It will take up, on an average, about 10 per cent of the dried fruit to dip it in boiling water and let it drain and dry off again until it is about moist enough to box; this brings back a good deal of the natural flavor and natural taste of the fruit, as a rule, besides killing the insects that are in it.

DISCUSSION ON MARKETING OF FRUIT.

Mr. Block: Mr. President, I did not seek to present this matter at this time, and endeavored to procure others to do so; but inasmuch as we are talking about drying and preparing fruit for market, I want to present something that will bring it home to you. The question is, how much are we getting for our fruit? Can we afford to raise it at the prices that we do? I will give you some figures based upon this measure, of the largest shipping that has been done by any party in this State for this year, and that will probably be a basis to estimate how much we fruit growers are getting for our fruit, if we ship it; to show who is getting the money and how much we are getting for our fruit. Most of you probably have seen the report in the papers about three weeks ago, that the results of the California Fruit Union sales this year in the East would be about $420,000 or thereabouts for fifteen million pounds. I have written to the "Fruit Grower," inquiring whether the amount they stated included the expense of packages, paper, packing, and loading; they said no. I made an application to other parties to get information as to how much we had been getting, and I find the figures $420,000 are not justified. We will not realize 2¼ cents a pound, paying our own expenses out of it; and our main expenses are boxes, paper, packing, and loading. You will probably be surprised if I tell you on a basis of eight hundred and fifty cars sold, carrying twelve million six hundred and two thousand one hundred and eighty pounds, sold gross for $773,117 06, out of which there was paid for freight, $345,156 28; for commissions, $77,298 06; cartage, $2,430; leaving as returns to the grower, $348,233 06. Deduct therefrom cost of crates, boxes, paper, packing, hauling, and loading expenses; take the average expense, and I am pretty near correct in saying that it amounts to 85 cents per one hundred pounds. This gives us $107,118 53 to deduct from the $348,233 06; consequently out of the $773,117 06, gross receipts, the grower realizes for the twelve and a half million pounds and over of fruit, $241,114 53, net.

The railroad realizes $345,156 28, and the commission man, $77,298 06. To simplify the matter, the above statement shows that where the fruit grower realizes for growing, including cultivation, taxes, packing, and taking all the risk of shipping, $100, the railroad receives for carrying the same about $150. Now, this is a very important matter. The question with me is, can we afford to raise the fruit? Some of you gentlemen are selling fruit to the shipper, and you say, "I don't care, I am going to sell to the shipper." But the shipper that buys your fruit has these expenses to pay; can he afford to do so and continue paying you the price that he is paying? I have seen a statement made in print lately that California grapes have been selling in the East at $200 a ton. Now, I have a statement of the very highest price that grapes sold for, and there is nothing of the kind. It has also been stated that the railroad charges $30 per ton, whereas the truth is that the railroad charges $75 per ton. I stake my reputation on the assertion and challenge any one to dispute it, that to average all the fruit sent East this year the shipper has not realized $10 a ton for his fruit, net. Now, shall we allow ourselves to be fooled by parties who come in here and tell us we are getting rich?

Mr. Hatch: I desire to mention that grapes sold for $200 a ton referred to the retail rates.

Mr. Block: I have been a shipper of grapes, and have received some of the highest prices and some of the lowest; and I tell you that I hardly realized a cent out of grapes, and they were as fine as any we have had. People are employed to give us information. We are tickled; we are pleased to hear that we are doing well; that we are growing rich; we laugh to hear it; but when we come home to pay our taxes, and to pay our help, we sometimes have to hunt around to see where we can get the wherewith to do it. I have shown you that the railroad company is getting $246 to your $100, and I could show you more, only I don't want to go so far into detail. For years I am taxed to pay the railroad debt of $300,000 that my county donated the railroad, and we have to pay every year the interest and a part of a sinking fund towards it, and in the State we do the same thing. Now, gentlemen, I suggest that a committee be appointed by this body to investigate the matter that I have stated here; to go to the California Fruit Union and tell them to give you exact returns as soon as they can make them out; to investigate this statement, and ask the Boards of Trade in every city in the State to coöperate with you and compel the railroad to meet us and give us a living rate; we are all interested; in the whole community there is not a member that is not interested with us in this work.

Mr. W. H. Aiken, of Wrights: To bring this matter in its proper form before this body, I move that a committee of five be appointed by the Chair, to act in connection with a like committee to be appointed by the Fruit Union, to wait upon the railroad authorities and obtain better rates for eastern shipping. Such committee to report to the annual meeting of the Fruit Union and also to the spring session of this Convention the results of their effort.

Mr. Block: I second the motion; and will amend by asking the coöperation of the State Board of Trade and that of every Chamber of Commerce in this State.

Mr. Aiken: I will accept that, for the committee to coöperate with committees appointed from any other body.

Adopted.

Note.—The above figures are modified from the report of the Secretary of the California Fruit Union.

Mr. Hutchinson: I would like to ask what percentage of fruit raised is fit to be shipped East?

Mr. Hatch: In those localities where they make a specialty of growing peaches for eastern shipment they *can* raise them so that all are fit to ship. In other words, Mr. Smith will tell you that in Vaca Valley, where they are growing peaches to ship, they raise them almost the size and shape they want them for eastern shipment. This is done by thinning and picking, and attention to all the details, but the proportion that *is* raised that is fit to ship is, this year, about one pound in ten.

CITRUS CULTURE.

ORANGE GROWING IN BUTTE COUNTY.

Mr. Jesse Wood, of Chico: The shortest speech ever reported was that of Dean Swift, who was once requested to make an address and take up a collection for the orphans of an asylum. He gathered all the children on the front seat, and when the time came for his address he simply waved his hand and said, "There they are, proceed with the collection." All I have got to say is, "Here they are" (showing oranges), and that is speech enough. I want to say, however, these are seedling oranges, from trees that I planted with my own hands on perfectly new ground that had never been broken by the plow—Government land that I took up in the hills near Chico—and I was in such a hurry to get some orange trees planted that I didn't wait to plow the ground. I took it just as nature had left it, and plowed it the best I could and spaded around the trees. Of course, I planted nothing but seedlings, for we had nothing but seedlings in Butte County. There was but one man in the county at that time that had any budded fruit at all—Mr. Wilcox, of Oroville. Since then I have planted budded trees, and also a great many seedlings. I have seven and a half acres growing, and three thousand little trees getting ready to grow, now two and three years old. I expect to increase my orchards until I have twenty acres at least of orange trees, besides some olives and grapes. We have been saying here, from time to time, that we grow fruit for money, not altogether for glory. I grow it partly for money, partly for glory, and partly for the fun of the thing—if there was not any money in it at all I should want to grow all the trees I possibly could on my place. I was a Methodist preacher some fifteen or twenty years in my life, and traveled from place to place, and I never lived in a parsonage in all that time but I planted a tree in the yard, and if there is anything that I want to thank God right now for it is that he planted that sentiment in my heart. We grow oranges here in Butte County, very much like these, as high up as twelve hundred feet above sea level—at Cherokee, the old mining town, between eleven and twelve hundred feet above sea level—and they bear very luxuriantly; and in different places, all over the county, they have a few trees. One place, about a thousand feet above Oroville, they grew trees from the seed and fruited in seven years; but there was a Frenchman there, and he made them bear very rapidly. In the valley, here in Chico, there are a number of trees bearing, notwithstanding we had snow on the ground last winter for two solid weeks. I was editor of a daily newspaper here, and took particular pains not to say anything about it. There is no harm to tell it now, because our orange trees were not all killed, but at that time I wouldn't give a two-cent piece for all the oranges in this county. At Oroville, and in our place in the foothills, there were three winters in succession during which there were only three nights the entire winter when we had any frost at all, and that was during the last week in December and the last week in January, at an elevation of three hundred feet above the valley; about six hundred feet above sea level. At Biggs and Gridley, as you pass along the railroad, they have orange trees bearing finely. At a place across the river on the Colusa side, orange trees have borne finely for several years, and this year, after such a winter as we had last year, it is an astonishing fact that the trees here in Chico, and everywhere else, are loaded with fruit. Now we don't claim that Chico is particularly an orange region, but the foothills we claim are equal to Riverside, Los Angeles, or any other place—not that I say Butte County, but from Shasta to San Diego; it is all California, and it is all a matter of locality. Get into a sheltered nook anywhere along the Sierras, and you can grow such oranges as these seedlings, and in the most sheltered places you can grow the most tender varieties of the budded plants. I had lemons also this last season, and although we had no snow on my place at all, when they had it for two weeks on the ground here, I did have ice half an inch thick and the ground froze six inches deep night after night. I say I wouldn't have given anything for the trees at all and thought the last citrus fair had been held in Butte County, but even the lemon trees at my place after such a season as that were not killed; the outer limbs were killed but the stocks were alive, and are now coming on and spreading finely. I had thirty-two lime trees on my place; they were killed to the ground and at least half of them are sprouting out and have sprouts on three feet high. That tells the whole story, gentlemen; any of you that want to go into orange culture need not go to San Diego to do it. I would not advise you to go to the top of Shasta, but simply to any sheltered nook along these foothills in Butte County and in Tehama—all along this coast. It is a remarkable fact that after the frost of last winter, the orange trees are more loaded this year than they were last. Another remarkable fact is that our fruit is ripe six weeks before the fruit of Lower California.

Mr. F. A. Kimball: These oranges exhibited are in an exceedingly unripe state, not nearly gotten their growth.

Mr. Wood: We do not say they are ripe, but we say they are six weeks riper than yours.

Mr. F. A. Kimball: I think you have the advantage of nearer three months in ripeness; we won't have a ripe orange in San Diego until the very last of March. This orange only has to be examined by the side of a fine orange to show its character, and if it is approaching anywhere near its ripeness it could not be considered by an expert as being up to the standard.

FLORAL CULTURE.

Essay by Emory E. Smith, San Francisco.

The word "horticulture," when used in European countries, is intended to convey a general idea of all things pertaining to gardening pursuits. In the United States, with our business intensity, there has been manifested, in the last few years, a strong tendency to separate horticulture into three distinct classes: fruit growers, floriculturists, and vegetable or market gardeners.

California, which at this time is the most rapidly developing portion of the United States, exhibits more decidedly than any other portion of the country, this tendency to sever these mutual interests.

To a certain extent this is proving disastrous to our general horticultural prosperity, by drawing the attention of the public exclusively to the stronger division, "fruit growing," thus bringing about the dependence of the State upon one branch of industry; notwithstanding statistics prove that countries which are the most truly prosperous have many resources.

Vegetable gardening, one of the most important of healthful food supplies, has suffered the most seriously, and so great has been the neglect of this important industry, that we pay annual tribute to Chinese and Italian peddlers (perhaps millions of dollars), to furnish us with the every day food with which our own gardens should supply us.

Floriculture, ornamentally speaking, has been one of the chief agents in attracting to California the thousands of prosperous settlers who have built our cities and redeemed much of the waste land from the jack rabbit and coyote, and are now making it blossom and bring forth our luscious fruits, which have become so famous in the various marts of the world.

Deprive California of its beautiful climbers, palms, magnolias, and other graceful evergreens, destroy the fragrant roses, and this famed country would be a dreary waste, in which but few would care to remain. This contrast is drawn to show the vast importance of home and wayside adornment. Each ornamental tree and flower that is planted is of intrinsic value to every industry. The spirit of adornment should be fostered by careful thought and concentrated action; for the land of balmy odor-laden breezes, radiant with sunshine, bedecked with graceful evergreens, and brilliant with the varied hues of the rarest flowers, soft velvety lawns, and orchards in which delicious fruits are ever ripe, is the ideal for which all are searching, and which is within the possibilities of California.

Floriculture in our State, commercially speaking, is now entering upon a new era, and the probabilities are that in years to come it will rival and be second only in commercial importance to the fruit industry. The State Floral Society, which has recently been organized under the most auspicious circumstances, has a future brilliant with educational possibilities, which will play no unimportant part in the future development of the State, and I bespeak for it the good will and hearty coöperation of all those who would see our country the veritable paradise to which it has been so aptly likened. It is the earnest expressed desire of this association to form floral clubs in the various portions of the State to further the interest of this industry, and provision has been made for Presidents of all such clubs to be Vice-Presidents of the State Society.

The soil and water supply of California is varied to a degree that admits of the most intricate methods of cultivation, and the climate, though mild and sometimes warm, does not cause the lassitude so destructive to the commercial enterprises of some countries.

So far as I have been able to ascertain there is no similar area of country in the world in which there can be grown successfully so many flowers, bulbs, trees, and plants, of the various zones.

It has been an open secret for some time that California would, in the near future, be a formidable rival to France, Holland, and Germany, in the production of flowers, seeds, and bulbs, which it now costs the United States millions of dollars yearly to import. Just here I will say that many of the high priced seeds in fancy packages which are brought from the Eastern States originally, are grown in California.

Systematic experimenting has proven beyond doubt that our flower seeds mature better, keep longer, and have a higher germinating power than those produced in other countries.

Most of the flowering bulbs grow, multiply, and mature unusually well in many parts of the State, and we have a much larger acreage suitable to their highest cultural perfection than has Holland or Germany. A few days ago, while walking by courtesy through the beautiful grounds of a Chico gentleman, he pointed to a lot of tuberoses and said: "They are very fine; I got them from Boston." Mr. President, ladies and gentlemen, California raises the best of everything, and instead of sending our money to Boston, we should send Boston our products with compliments.

The large variety of rare ornamental and flowering plants that can be grown here, at small expense, and California's proximity to Mexico, Western, Central, and South America, Australia, Japan, China, and the Pacific Islands, entitle our florists and nurserymen to a very large exporting and importing trade.

Eastern dealers are evincing their faith in our future floral greatness by eagerly purchasing all the floral products which are offered in a salable condition, and a limited export trade with the European countries has sprung up in the last two years. What is most needed to develop these valuable branches of trade is men experienced in the business, who are willing to invest money, and wait a reasonable time for the development and returns which are sure to be highly satisfactory.

Among other developing floral enterprises, hybridizing for new varieties will no doubt some day bring fame and fortune to our State, for no other country can boast of such favorable conditions for the prosecution of this art, and the door stands wide open to genius and perseverance.

The shipping of orange blossoms has become a source of increasing revenue, and cut flowers have been successfully transported to the Middle and Eastern States.

The manufacture of perfumes has been retarded by the lack of a knowledge of the business, and tons of blossoms perish that should be a source of wealth. There is a mistaken idea sometimes expressed, that our flowers are not so fragrant as those of other countries. This is, of course, untrue. The growing of medicinal plants also is an infant industry, which bids fair to supply America with the greater portion of her own drugs, thereby greatly reducing the tribute paid to the foreign countries from where nearly all are now brought.

The growing of plants for dyes and textures has proved successful, and is rapidly being developed.

The intrinsic value to California of this floral future lies in the utilization of her broad uncultivated acres and the general prosperous independence of her people; for in Flora's dominion, unlike any other, there is work, health, and happiness for every man, woman, and child.

None of the horticultural industries of California can be fully developed until we have located in our State a great and perhaps national botanical garden, in the grounds and conservatories of which there could be collected the florals, both useful and ornamental, from the various portions of the earth. It should be a national school to which all could go and drink to the fill of accumulated knowledge, and should be free to all.

How shall we hasten this cultural magnificence which is waiting to transform our State into a fairer picture than poet's pen has ever traced? "By scattering seeds of flowers by the wayside everywhere," by scattering seeds of floral love in the hearts of our children, by embowering our homes in fragant flowers, by voting to line the highways with trees and shrubs, and by freely disseminating such knowledge as we may possess or acquire, that others may be encouraged to love and cultivate the flowers, the crowning glory of California.

In conclusion I will say, that it is hoped that we will find it expedient to have assembled in the spring or a year hence a grand floral congress in San Francisco, that will attract people from all over the country to see our remarkable floral products, and hear our own floriculturists discourse, as well as noted floriculturists from several portions of the United States, and we ask that you earnestly coöperate with us in all that pertains to the developing of this important industry in California.

DISCUSSION.

Mr. White: I would speak of some of our California native woods for ornamenting our yards and homes. We have in the redwood regions the genuine Yew of Europe, and it attains a larger size here than elsewhere, a most beautiful ornamental tree; and, then, perhaps you know that far back there was a cedar discovered in Port Orford which has been used largely for inside blinds, and there is no wood that rivals it for that purpose and general finishing purposes in the finest of dwellings, and it is one of the most beautiful ornamental trees when properly looked after. Only a few miles from National City you will find a rare pine, I believe found nowhere else in the world, which may be made one of the most ornamental of trees. Now the evergreen we use for hedges, the Monterey cypress, is peculiar to that, and we have a pine peculiar to the same section of country, and if you go a little farther north a good many shrubs in the hills—the calycanthus, I have it growing in my yard, a beautiful shrub, flowering. Then we have the native nutmeg tree of California, I have it in my yard, one of the most beautiful ornamental trees that we have; I have acacias from Africa and from India; but, sir, I would not exchange that native nutmeg tree of California for any of these different varieties of trees; then we have a holly growing in these cañons, and the black walnut, and then the laurel is a beautiful tree, and some of the most beautiful and costly furniture ever manufactured in the State of California has been made from that—it bears a very high polish; then I consider the manzanita, if properly looked after, is a pretty shrub—"little apple" is the meaning of the word, and it is essentially a minute apple. I have also the madrone, and it is an exceedingly beautiful tree, and I was greatly astonished at a lady who has spent a number of years in California asking what tree that was. There is a great ignorance among the people who live here of the beauties of our forests. Even the buckeye, if properly trimmed and propagated, is very ornamental; there is nothing that we have in the landscape more beautiful than the buckeye in bloom, with the two varieties, pink and white. Why should we discard these trees and these shrubs? Do we want to beautify our homes in proportion to our climate and in proportion to the beauty of the scenery with which we are surrounded, and with the paradise of nature painted on almost every mountain side? It is painted almost; look at it as you see them all in purple and clothed in gold. Shall our homes be wanting, and not in harmony with the paintings of nature itself? I want our homes to be like so many stars set in this beautiful land, not alone surrounded with flowers and shrubbery and ornamental trees, but to be genuine nurseries of happiness. Oh, what memories come to mind at the very word home—mirth, singing of children, youth, sacred to every human heart, how sacred they may be made here in California to every glad opening mind, how precious they may become! Do we keep our homes housed with all that is worthy? As fruit growers, as citizens, as dealers in God's most favored land, let us make our homes, keep them to dwell in, spending the years of our life in, and when the last summons comes, take our final rest in the higher and broader and better world above.

XXXI.

SYNOPSIS OF PROCEEDINGS OF THE ELEVENTH STATE FRUIT GROWERS' CONVENTION.

[Held under the auspices of the State Board of Horticulture, at National City, San Diego County, commencing Tuesday, April 16, and ending Friday, April 19, 1889.]

President of the Convention, Hon. Ellwood Cooper, presided, and announced that, this being the time designated in the call for the meeting, the Convention would come to order.

Prayer by the Rev. N. R. Peck, of Penryn.

Mr. Warren C. Kimball, of National City, and Mr. T. J. Swayne, of Paradise Valley, were elected Vice-Presidents by acclamation.

OPENING ADDRESS.

By Hon. Ellwood Cooper, of Santa Barbara, President of the Convention.

Ladies and Gentlemen: This will be the eleventh State Fruit Growers' Convention, and the seventh held under the auspices of the State Board of Horticulture.

At the last Convention, held in Chico, November twentieth to twenty-fourth, inclusive, the subjects discussed took rather a wider range than at any previous one. We had a most interesting meeting, well attended; members expressed themselves as being edified, and all thought it was one of profit. The subjects that elicited the most diversified opinions were "Insect Pests," "The Olive," and "Pruning." There was a very great difference of opinion regarding varieties of the olive. I have prepared a brief paper on the subject, which is before the Convention, and it will appear in its proper place on the programme. There was some difference of opinion regarding the methods of pruning, and there appeared to be a doubt as to the better one. All, however, were in favor of low pruning. I have a paper to present on high pruning, when this subject is under discussion.

Much alarm was manifested on account of the ravages of the *Icerya purchasi*, and information is wanted how best to arrest the spread of this dangerous insect. No new discoveries in remedies, so far as I have learned, have been made.

I have been informed, through the newspapers, that several varieties of predaceous insects, to prey upon the Icerya, have been received in Los Angeles from Australia or New Zealand, and I trust a full report on this experiment will be made at this Convention. I have also been informed by gentlemen living in San Gabriel Valley that some disease or some insect was destroying the Icerya almost entirely in some orchards. I have invited reports on this, and trust we will have the same during our session.

The curled leaf on the peach was not scientifically understood. The pear blight as it appeared in some localities was discussed, resulting in many different views given on the subject.

Irrigation and non-irrigation occupied considerable time. Some were enthusiastic as to the thorough cultivation without irrigation producing a firmer and better fruit, while others with equal force claimed that with careful irrigation the best results were obtained, and just as firm and good sound fruit produced. A large allowance must be made for the difference in localities, and whether in bottom or on table lands.

A very interesting essay by General Chipman, "Wheat vs. Fruit," was read at the Chico Convention, and will be found in our reports. This essay was valuable for many reasons. It showed the average crop—how very small as compared with the product of the intelligent and provident cultivator. It pointed out where wheat lands had at one time produced sixty to seventy bushels to the acre, they now produced only fifteen—one fourth as much; this result owing entirely to the want of fertilizing. It gave the whole number of pounds of ripe fruit shipped by the California Fruit Union, with the net average price received. Some of the shipments gave as high as 10 cents, while others did not bring sufficient to pay the freight. Such statistics do not represent the fruit industry as conducted by intelligent fruit growers. I will state that while the deductions from the average crops show absolutely the true condition of the prosperity of the country, we do not hold out to new orchardists any such gloomy showing. While correct as statistics, it is not correct as the result of the intelligent fruit industry. The average results from the different orchards of careful, intelligent, and industrious fruit growers are what we hold out as possible for every new cultivator who embarks in the business.

Complaints have been made by careful fruit shippers of their losses sustained by reason of shipments of unsound fruit sent at the same time as their shipments. Unsound fruit shipments were forced on the market at such prices as prevented the disposal of the sound fruits at prices which would net a fair return to the owners. Such a condition of things should not be permitted. This brings me to the point which I intended to advocate as one of the important measures to be adopted by the fruit growers, that is: "Fruit Inspection."

The importance of such a measure cannot be more forcibly presented than by quoting from the address of Parker Earle, President of the American Horticultural Society, delivered at San José, January twenty-fourth, last year. He said:

> I am a fruit grower, a fruit packer, and a fruit buyer, and I stand here in all three capacities to protest, in all the earnestness of my soul, against all kinds of deception in fruit packing. You cannot afford to pay freight on trash two or three thousand miles. It cannot be too often or too earnestly impressed upon fruit men everywhere that to secure the best results the most scrupulous pains must be taken, not only in growing fruit properly, but in careful handling, thorough grading, and unflinching honesty in packing.

I have been familiar, since my earliest boyhood, with the inspection laws existing in the Atlantic seaboard cities. Many of the staple articles were subjected to a careful examination before being offered for sale. Flour, if short in weight, was confiscated; if not equal in quality to the standard requirements, was marked so that all purchasers were aware of its inferiority. Butter, if short in weight, was confiscated. Meat, if tainted, was confiscated. Pork, in barrels, was subjected to the same rigid rules as flour.

No one ever pretended that these ironclad inspection laws worked injury to the people; on the contrary, considered them a necessity, in order to protect consumers from fraud.

Regarding our fruit shipments, there is no excuse for those who ship unsound fruit. In our published reports all the information is given. Four times out of five, shipments of unsound fruit give a loss to the owner. If this were all, it would not so materially concern the great body of shippers; but the markets are injured by the forced sales of the unsound and worthless shipments, hence the necessity of inspection at the place of shipment. Again we pay a fixed rate of freight to the railroad companies, for a fixed time in transportation. The railroads should be compelled to insure the time. We have no control over the management and no recourse where losses are sustained by reason of delays.

At every previous Convention, where I have had the honor to preside, I have called your attention to the importance of proper distribution of our fruits. It seems to me that this question is paramount to every other, excepting only the question of "Insect Pests." I was particularly impressed with that portion of the opening address of Parker Earle, already referred to. I quote from page 34, under the head of "Fruit Growing:"

> It appears to me that there is no subject of more immediate practical interest to the commercial fruit grower than this one of the means of a wide distribution. The fault is with our transportation, and our lack of any far-reaching and elaborate system of distribution. I think I have known good oranges to sell at not much over one cent apiece at wholesale in Chicago, the market being overloaded, when there were a thousand towns within a day's ride of that city in which you could not buy an orange for less than five cents—and not many at that—and millions of people within the same radius who did not taste an orange in the whole winter. So many of our available markets are not reached, and the fruit grower suffers from an apparent over-production, when half the people go hungry for fruits which they need and cannot obtain.

Fruit trees are being planted by the millions in California, and I cannot too forcibly impress upon you the importance of this problem: How are we to dispose of the fruit without loss to the producer?

The Legislature has increased the appropriation for horticultural purposes; amended the law so as to permit more efficient work; appropriated $5,000 for entomological field work; amended the law for the prevention of the spread of insect pests. This law gives the power to the people of any district to compel the owners of orchards to employ every possible means to destroy the insects infesting orchards, or, in the absence of such energetic work, to destroy the orchards by rooting out and burning up the trees, at the expense of the owners.

This thoughtful and wise legislation is very commendable, and our legislators should have our thanks. It is our desire and hope that we can accomplish greater good; but we will require the support of the great body of fruit growers. We wish to coöperate with them. We will not only have the opportunity of interchanging ideas on all subjects appertaining to horticultural pursuits at the semi-annual Fruit Growers' Convention, but also through the medium of correspondence with our central office, 220 Sutter Street, San Francisco, where efficient and competent persons will always be present to answer correspondents.

We have been fully aware of the greater responsibilities involved in demanding of the Legislature better laws and more money, but we have done so with the conviction that the fruit industry required it. We will rely upon the concerted action of interested fruit growers, so as to accomplish the greatest possible good for the expenditure.

The law permits responsible and competent fruit growers, by and with the advice and under the direction of the State Board of Horticulture, to make experiments in destroying insect pests, in their own orchards or districts at the expense of the State, but in order to obtain this permission a written demand must be made giving the nature of the experiment, the formula, how to be applied, upon what variety of fruit trees, and upon what kind of insects. It will be expected before such permission is granted that only the actual cost of materials and hired help will be included as the expense involved in such estimates. The orchardists who may profit by such experiment in such districts will be expected to give their time freely and willingly in overseeing such experiments free from charge.

ADDRESS OF WELCOME.

Delivered by Mrs. Flora M. Kimball, of National City.

Mr. President, Gentlemen of the State Board of Horticulure, and Fruit Growers of California: In behalf of the citizens of National City and every other resident of San Diego County, I extend to you all a most heartfelt welcome. Why I was commissioned to perform this pleasant duty I cannot conjecture, unless, having so many eloquent gentlemen among us, it was impossible to choose from the number the one most gifted in speech, and so, setting eloquence and learning aside, the lot fell to one who could excite neither envy nor jealousy; yet one most thoroughly in sympathy with the work to which you have dedicated your lives, and are giving so liberally of your intellect, as well as time.

Could you have known what enthusiasm possessed us all when it was publicly announced that National City was to be honored with the eleventh annual Convention of Fruit Growers, you would need no address of welcome to emphasize the fact that we are glad to see you.

The ancient argonauts who braved the perils of the sea to recover the golden fleece, and the argonauts of '49 who invaded these unknown shores in search of gold, were indeed heroes; but you, our horticultural argonauts, who explore the hidden mysteries of nature, and bring forth her secrets for the improvement and perfection of our golden fruits, are both heroes and benefactors, and are closely allied to our homes and hearts.

I can easily forgive the idolatry of the ancients who worshiped trees. They must have possessed esthetic and refined natures, and if unable to grasp the idea of the Creator, centered their worship on one of His noblest creations.

You come to us, gentlemen, not as horticulturists alone, but as apostles of the gospel of fruit, trees, and flowers. We recognize the truth that planting trees, garnering fruits, and developing new forms of vegetation, is not your highest work. A richer harvest than the merely economic awaits your labors. We rejoice in your presence to-day, not so much from anticipated benefits to our horticultural industries as from the richer harvest of morality, beauty, and religion that will spring from the scattered seed of thought you have brought to us. No nature is so depraved that it does not respond to the refining influences of trees, flowers, and fruits; and none so perfect that it may not be made purer and better by their blessed presence. Hence, we are doubly glad to have the opportunity of extending this welcome, because we appreciate the great value of your dual work, and anticipate greater results from this Convention than anything that has been promised us.

We beg you to close your eyes to our uncultivated mesas and valleys, for we would not have you compare them with the magnificent stretches of orchards in your more northern homes, remembering only that San Diego is the infant in the large family of counties, but we hope by nature as smart as the rest, and when she gets a little older we will be pleased to show you again what she has accomplished in the line of horticulture.

Nature, lavish in her gifts to every portion of the State, has dealt generously with us. She has given us a soil responsive to man's efforts, furnished huge basins for the storage of water abundantly supplied, and but yesterday the cunning hand of man commenced its task of aiding in the work of storing for all future time.

It is scarcely two decades since the Yankee's plowshare, following in the wake of the retreating herds of Mexican cattle, turned the virgin soil to the warm sunshine; while the fruits before you are the product of trees, the oldest of which have scarcely entered their teens. In our horticultural infancy it is a matter of pride that we are a part of this great commonwealth, and when California sends annually to eastern markets her thousands of carloads of fresh deciduous fruits; canned fruits of upwards of a million of dollars in value; from her vineyards eight hundred thousand boxes of raisins, and a vintage of eighteen millions of gallons, and oranges by the thousands of carloads, we say, with the pardonable satisfaction of old Californians, *we* do these wonderful things; and when we see it estimated that 1890 will find one million orange trees of bearing age in Southern California, we may be pardoned for a stronger emphasis on *we*, when we shall say, *we* have done this also.

I have unbounded faith in the moral and mental curative properties of trees and flowers, and I would be glad if the power of locating insane asylums, boys and girls reformatories, and homes for the aged, was vested in a Board of Horticulture. I believe it would go outside the poisonous atmosphere of cities, and plant these homes for the homeless and unfortunate in broad orchards, where the luscious fruits, the delightful shade, and sweet flowers should be as free as the pure country air.

Cities have been aptly called necessary evils, which, while they serve the lower purposes of commercial centers, they do not possess the elements that restore unbalanced reason, nor the peace and quiet so essential to those nearing the sunset of life; nor remedies for the moral delinquencies of youth. Give a mischievous city lad a dozen fine fruit trees, all for his very own, his to cultivate and enjoy the fruit thereof, and his early reformation may be safely predicted. I pity the child whose lot is cast among the piles of brick and mortar of cities, whose feet have never touched the soft, yielding grass, and whose heart has not beat with joy in the shadowy embrace of open-armed trees, whose childish appetite has never been appeased with fruit, and whose sense of beauty has not been ministered to by the happy, laughing flowers. Our world's waifs can only hope for happiness through work like yours.

That venerable horticulturist, Rev. A. B. Mussey, of Cambridge, his co-worker, Thomas G. Fessenden, and other eminent thinkers, venture the assertion that an unlimited use of fresh fruits as food will ultimately satisfy the craving for intoxicating stimulants; and so I might add the asylum for the inebriate as one of the institutions that ought to be established in a fruit orchard, and the advancement of the temperance cause as another of your moral missions.

One of our sweetest singers has grandly said:

"Give fools their gold and knaves their power;
Let fortune's bubbles rise and fall;
Who sows a field, or trains a flower,
Or plants a tree, is more than all."

I voice the sentiment of San Diego County's fifty thousand people when I thank you for your presence here to-day. To-day inaugurates an era in our history from which we expect to date a new awakening in the best pursuits of human kind, but better still the strengthening of the bond that binds in one common brotherhood the northern and southern portions of our beloved California.

Whatever there is in our little town or environments that possesses historic or present interest, we trust you will for the time being consider your own, and enjoy the fullest measure of all presented to you; and when this pleasant session is ended, and you leave for your own homes again, may you bear with you as kind remembrances of us as we shall ever retain of you and your work.

Since coming into the hall I am reminded that one hundred years ago to-day, April 16, 1789, Washington started from Mount Vernon on his inaugural march to New York, to be inaugurated as the first President of the United States. All along the route he received an ovation. His path was strewn with flowers by the ladies of the land, while men, women, and children vied with each other to do him honor. It is safe to assume, however, that Washington never witnessed such a scene as this done in honor of President Cooper and his co-workers. [Great and prolonged applause.]

INJURIOUS INSECTS AND REMEDIES.

Essay by PROF. D. W. COQUILLETT, Los Angeles.

Any person writing on the subject of injurious insects on this coast, is naturally expected to devote a large portion of his space to a consideration of the scale insects, these being by far the most destructive pests with which our fruit growers have to contend. Of course, in those localities where apples and pears are largely grown, the production of these fruits is sometimes very seriously interfered with by the depredations of the codlin moth (*Carpocapsa pomonella*, Linn.); still, as this pest attacks only a comparatively few different kinds of fruits, and does not in the least imperil the life of the trees, its destructiveness is scarcely equal to that wrought by the scale insects, one or more kinds of which attack almost every kind of fruit, nut, and ornamental tree grown on this coast, and by directing their attacks against the tree itself, either succeed in killing it outright or at least in reducing its vitality to such an extent as to render the tree more or less unproductive.

The scale insects naturally fall into two groups; in the one group the body of the insect is covered with a shell or scale, while in the other group it is not covered. The red scale (*Aspidiotus aurantii*, Maskell), which attacks citrus trees, and the pernicious scale (*Aspidiotus perniciosus*, Comstock), which confines its attacks to deciduous trees, are examples of those kinds which are covered with a shell or scale. The young ones, when first hatched, are provided with six legs and two antennæ, or feelers, and quite closely resemble small spiders. After issuing from the eggs they remain several hours, or even days, beneath the parent scale, then start out for themselves, and after wandering around for a short time they settle down in some suitable place and insert their beaks into the bark, leaves, or fruit, as the case may be, and proceed to imbibe the sap. Their bodies are provided, both above and below, with a vast number of secretory pores, somewhat resembling the sweat pores on our hands. A few hours after the young scale insect has commenced to imbibe the sap of the tree there issues from these pores a gummy substance somewhat like that with which the spider constructs his web or the silkworm his cocoon. The secreting of this gummy substance proceeds quite rapidly, so that at the end of twenty-four hours the young insect is entirely hidden from view beneath the secretion; the latter, as it hardens, assumes a white waxy appearance. At the end of several weeks the young scale insect casts off its old skin somewhat as a snake does, a new skin being formed beneath the old one before the latter is cast off, but in this new one no provision has been made for the legs and antennæ, so that henceforth these appendages disappear from view during the life of the female insect, although the males regain them again in the adult state. After casting its skin, the secreting of the waxy substance continues, forming a shell or scale both above and below the insect, so that the latter becomes incased between two shells, somewhat as the body of a turtle is. The two shells are not joined together so tightly as to exclude the air, this being quite as essential to these lowly creatures as it is to the higher animals.

After once the young female insect settles down she does not afterward change her position, and the only change that occurs is the occasional casting of the skin until the egg-laying period arrives. Shortly after all of her eggs are laid the female dies a natural death. The males, as intimated above, finally acquire legs, antennæ, and wings, and somewhat resemble a mosquito, but are very minute, being scarcely discernible with the naked eye.

Of those scale insects which are never covered over with a shell, the Icerya, or cottony cushion scale (*Icerya purchasi*, Maskell), and the black scale (*Lecanium oleæ*, Bernard) are familiar examples. The young black scale is capable of walking about until nearly half grown, after which it settles down permanently and finally deposits eggs, the body shrinking away as the eggs are laid, and the body walls hardening, so that by the time all the eggs are laid the body is quite hard, and is hollow within, somewhat resembling a small cup inverted over the eggs.

The Icerya retains the use of her legs during her entire life, but like the black scale, she settles down permanently before the egg-laying period arrives. The eggs are deposited in a mass of cottony substance, which is secreted from minute pores situated on the under side of the body.

It is the remedies for the destruction of these pests that we are most interested in, so without going further into the life histories of these pests I will proceed to consider some of the remedies that have been successfully used against them.

REMEDIES.

Among the numerous remedies for the destruction of scale insects that I have tried, two of the most successful are: Fumigating with hydrogenic acid passed through sulphuric acid, and spraying with a solution of resin and caustic soda.

In a paper read at the Convention held at Santa Barbara one year ago, I gave a brief account of the fumigating with hydrogenic acid gas, and as this paper has been published in the last report of the Board, it will be needless for me to again describe the process here. A fuller account of this process is given in my report on the gas treatment, published in the report of our National Department of Agriculture for the year 1887, and a supplementary report is to be published in the report for 1888.

The principal drawback to the universal adoption of this process—the high price of the chemicals used—has been partially overcome. Mr. R. H. Gilman, who has constructed a fumigator of his own devising, informs me that with the one apparatus he treats on an average forty trees a day, at an average expense of 65 cents per tree, which includes labor and material. His trees are from twelve to fourteen feet high by the same in diameter. His fumigator is on the same principle as the one first devised by J. W. Wolfskill and Alexander Craw, of Los Angeles, except that in Mr. Gilman's fumigator the mast is attached to a turntable, by which device he is able to operate two tents with the one apparatus.

Mr. A. J. Haley, who has charge of the Culver fumigators, informs me that the cost of materials for treating orange trees twenty-six feet tall averages about 80 cents per tree, and that he treats trees of this size for $1 per tree. This reduces the cost for treating trees with this gas fully one half from the estimates given in my paper read at the Santa Barbara meeting.

The resin compound above referred to is a modification of one which Mr. Albert Keobele first used while carrying on a series of experiments. I gave a full account of its preparation and use in an article to the "Rural Californian," of Los Angeles; this article was also published in the "Secretary's Portfolio," in the last report of the State Board of Horticulture. Further experiments show that a slightly larger proportion of caustic soda than I have indicated should be used in order to obtain uniform results, since the caustic soda is not always of a uniform strength. The best results will be obtained by using one pound of caustic soda to eight of resin, and this quantity is sufficient to make thirty-two gallons of the wash. It is better to use too much than too little of the caustic soda. In the latter case the oily portion of the resin—which consists largely of the oil of turpentine—will not have become wholly saponified, and as a natural consequence the spray, when thrown upon the tree, will dry so rapidly that it will not have the desired effect upon the insects. Several cases of partial failures in the use of this wash have come to my notice, and in nearly every instance the cause was clearly traceable to having used too small a quantity of the caustic soda.

Better results will also be obtained by using an iron vessel for preparing the mixture in than if a tin one is used, since a considerable degree of heat is necessary in order to produce perfect saponification.

Several of my correspondents have used this wash in the proportion given above, and all who have expressed an opinion to me in regard to it speak very favorably of it. One fruit grower who used it quite extensively on orange trees for ridding them of the black scale, writes me that one day he sprayed several orange trees with it, and had scarcely finished the operation when a high, drying wind arose, and as a result, the trees so recently sprayed lost a large proportion of their leaves. That this was the direct result of the drying winds seems very certain, since at previous times when such a wind did not blow, he had used the same preparation on a great many of his orange trees without causing them to drop scarcely a leaf.

We have to learn to temper our tree washes to the varying conditions of wind and weather. It is very evident that when a tree is moist with the dew, fog, or rain, it will withstand a stronger application of the wash than it would if very dry; in the latter case, the liquid portion of the wash would rapidly be absorbed by the dry dust on the tree, so that a large proportion of the more solid portion of the wash would adhere to the tree; whereas, if the tree is damp at the time of applying the wash, much of the latter will necessarily run off. On this account, it would be advisable to use a stronger wash on trees already moist with the fog or dew than would be used on trees that are very dry.

The method of washing trees with pure cold water thrown upon them with considerable force is quite effectual when employed against the Icerya, and is being quite extensively used at the present time. I first saw it used in Los Angeles in 1886, and, in my report to the Department of Agriculture for that year, suggested that the force of the water in dislodging the insects would doubtless break off their beaks which were firmly imbedded in the bark, thus directly causing the death of these insects. Wishing to settle this point definitely, I collected twenty-five Iceryas from beneath an orange tree that had been washed about half an hour previously, and examined them with a compound microscope. All of them were adult females, except three, which were in the next stage preceding the adult stage. In twenty-three out of the twenty-five examined the beak had been broken off; in twenty of these it had been broken off close up to the tubercle from which it springs, so that not a vestige of it remained; but in the other three a portion of the beak remained, equaling about one fourth the original length of the beak. Of course, all of those Iceryas in which the whole or a portion of the beak had been broken off must necessarily perish of starvation.

This method would be still more effective if some kind of viscid substance was to be placed around the trunk of the tree in order to prevent the ascent again of those Iceryas that had been dislodged from the tree. One of the best preparations for this purpose known to me is composed of the following ingredients: resin, four ounces; beeswax, one ounce; cottonseed oil, five fluid ounces. The resin and beeswax are first melted together, after which the oil is added, and the whole thoroughly stirred; when cold it is ready for use. Some which I applied to the bark of an orange tree saturated the bark for about half an inch on each side of the band where I originally applied it. Owing to this property of the preparation, it is possible that it might prove an injury to the bark. A safer plan would be to first place around the trunk of the tree a bandage of thick building paper; or, what is still better, a bandage of sheepskin, placing the wool next to the bark, and applying the viscid preparation to the outside of this bandage. One application of this preparation after each washing of the tree would doubtless be sufficient, since it remains soft and sticky for about a week after it is applied, and by this time the Iceryas on the ground would either have found their way to the tree again, or would have wandered off to some other tree or plant.

I doubt that this method would prove equally effective when used against any of the other kinds of scale insects, especially those which are covered with a protecting shell; we could expect to dislodge these only when first they issue from the eggs, but owing to the fact that at the end of twenty-four hours after leaving the parent scale they are completely covered over with a waterproof covering, the time during which they could be dislodged from the tree by the use of water alone is confined to a few hours at the most.

The fruit growers of this coast have been fully aware of the great benefit derived from those insects which habitually prey upon the injurious ones, and at several of the biennial meetings held under the auspices of the State Board of Horticulture, resolutions have been unanimously adopted requesting Congress to appropriate a sufficient sum of money to enable one or more expert entomologists to be sent to foreign countries for the purpose of collecting and importing into this State such insects as habitually prey upon the various kinds of scale insects. While these resolutions have not been carried out to the letter, the object sought for has been at least partially obtained. There are three kinds of insects that were received from abroad, which give great promise of very materially lessening the number of the Iceryas on this coast. These are: a small black and red ladybug, a large lace-winged fly, and a small two-winged fly. The latter lays its eggs upon the bodies of the Iceryas, and the young that hatch from these eggs burrow into the bodies of the Iceryas, and live there until fully grown, when they contract into cylindrical pupæ, from which the winged flies finally issue; but before this takes place the infested scale is lifeless.

The two other kinds attack the Iceryas somewhat as a cat does a mouse. One of them, the black-and-red ladybug, is very voracious, and will evidently prove more useful than all of the others combined.

Assuming that one of the larva will destroy half a dozen Iceryas a day, which is a very low estimate, and that its life as larva is confined to a period of six weeks, it will during this time have destroyed over two hundred and fifty of the Iceryas. Then follows a period of about two weeks of life as a pupa, during which time it takes no food, after which the change to the winged beetle takes place, and as the latter also feeds upon the Iceryas, as I know from actual observations, the number of Iceryas destroyed by the one insect will be not a little increased over that given above. Fortunately quite a large number of these ladybugs have been received alive, and I have been enabled to colonize them not only upon an orange tree inclosed by a tent at Mr. Wolfskill's, in Los Angeles, but also on several orange trees in the open air at Colonel Dobbins' and at Mr. Chapman's, in the San Gabriel Valley, so that the successful introduction of this important insect into this State seems insured beyond a doubt.

It is to be regretted that no special insect enemies of the other scale insects were also obtained. Of course it is possible that the black-and-red ladybug above referred to will also attack them; but it is clearly a natural enemy of the Icerya, and would therefore prefer it to any other kind.

In the San Gabriel Valley a great many of the red scales (*Aspidiotus aurentii*, Maskell) are destroyed by internal parasites; as yet I have found no trace of them in the Santa Ana Valley. May not this account for the fact that the red scale is more destructive in the latter than in the former valley? It has been quite generally supposed that the red scales inhabiting these two valleys belong to two different species, owing mostly to the fact that they are not so destructive in the one valley as they are in the other; but the presence or absence of their minute insect enemies would be quite sufficient to account for this difference. Much good might be accomplished by introducing these enemies of the scales into those localities where they do not already exist.

While it is devoutly to be hoped that these natural enemies of the scale insects will soon increase to such an extent as to be able to keep these pests within due limits, still it would be very unwise for the owners of infested trees to stand idly by and wait for this time to arrive. Active efforts should be made by artificial means to subdue these pests wherever they occur, and in the meantime every effort should be made for fostering and disseminating their natural enemies.

DISCUSSION.

A long discussion on insect pests and remedies followed, in which all were interested. The discussion was of great benefit to those present, giving them encouragement and renewing their faith in the work of fruit growing, each resolving not to give up to the bugs. The various remedies and their application have been published in the reports and bulletins of this Board.

PRUNING AND CULTIVATION.

Essay by Hon. Ellwood Cooper, Santa Barbara.

This subject has been very fully discussed at almost every previous Convention; hence the necessity of careful investigation of theories, in regard to which a great difference of opinion exists.

It would be well first to consider the physical structure of the plant, its constitution, and what sort of training will best develop it for future uses. All of us know, as far as the animal kingdom is concerned, that we should aim first at the cultivation of a strong body. The more symmetrical it is the greater is the strength and the greater the power of endurance. In the human species the fruit is the measure of the mental, moral, and spiritual powers; but no matter how much we devote our attention to the cultivation of these powers, if the physical part be neglected and the constitution weak, we do not expect that full result we otherwise would if the body and constitution were vigorous. Just so we should reason regarding the plant, and first devote our attention to the trunk and its branches. They should be naturally developed. If you cut off the stem close to the ground, you will never have a natural tree; you never can have a tree of near its full size; in other words, you cultivate a bush.

Much has been said about the fruit trees running out and failing to reproduce themselves from their seeds, and their being in a few years subject to all kinds of diseases, and failing to live and give the fruit that was expected. This failure has been attributed to continued ingrafting, no account being taken of the continued fruit forcing. In my opinion, it is wholly due to the latter course.

A close observer will notice that in all cases the graft will grow more vigorously on seedling trees than the stock itself. The graft produces thrifty trees when it gets the proper healthy circulation of sap, but when the stock is unhealthy, all its forces are soon given out at an early age, and the plant generally dies. If you force the intellectual training of your children, you will develop the brain too rapidly, which will rob the vitality, and they may die before they reach that age at which they could reproduce themselves. At any rate, continue such a training and in a few generations the race would run out. It is none the less true with plant life.

We come now to the question: What is the natural condition of these trees? Most of you, perhaps, have seen the wild cherry, the wild peach, the wild plum, the crabapple; if not these, other trees growing in their wild natural state, and where not growing too thickly, they all have well developed trunks, at least six feet high from the ground, with a leader from which come the branches symmetrical on every side; in other words, you see a perfect tree, capable of resisting all the elements, planted by nature, in its natural condition, which will live for a very long period. Why do you send to these trees for seeds? Because their life-germ is perfect; they have not been scalped and forced by unnatural conditions, and rendered unfit for reproduction. The thing to do, therefore, in fruit growing, is to devote everything to the trunk and its branches during the first few years. Cultivate a trunk at least five to five and a half feet from the ground. Cultivate a leader from that trunk, and lateral branches, always with an upward tendency. You will have a tree in fifteen or twenty years that will bear two, three, and four times as much fruit. You will have a tree to give fruit after three or four generations of your trees are gone. I will admit that your so called scientifically pruned trees, as described by the different members and accepted as the thing to do to get the best result, will give fruit earlier, that it will be more cheaply gathered, and that the trunk will be protected from the sun; but if we are planting an orchard for twenty-five or one hundred years, there will be no such comparison. The trunk can easily be protected by artificial means for ten years.

As to picking, some way should be devised to overcome the difficulties by a small outlay. Should you take six or seven years to cultivate and train your tree, without any fruit, you would be greatly the gainer in the end.

Scientifically, I am opposed to your scalping method. First, last, and always, I believe in high pruning, and in training a tree as it was naturally intended to grow. You cannot get fruit without wood and leaves. The nearer you approach the natural condition, the better and stronger the wood and leaves, and the better and stronger the fruit. In less than another generation this will be better understood, and low pruning a thing of the past.

DISCUSSION ON PRUNING.

Mr. Motheral: I would like to say that your essay is at war with my habit and practice from beginning to end, and if you are right I am all wrong. I have found out that on my place the knife is the life of the peach tree especially, and that if I prune high I have the borer that kills my tree, so I have to prune low to protect it from the sun and the borer; that is likewise the experience with the apple, the prune, the peach, the nectarine, and the apricot. The pears do not hurt quite so bad, but still the borer troubles them all; we can't have fruit trees and train them high. I have trees I failed to prune for two or three years and they absolutely went back on me, and I believe would have died, but I went in and vigorously used the knife, cut them way back, and they are sound and bearing trees now. In commencing an orchard I would prune to within a foot or two feet and a half from the ground, start them there, and after they get a little older I may cut them out; I get them up a little, but I do not get them up very high.

Mr. Thomas, of Visalia: I am inclined to think that in our country if you would adopt Mr. Cooper's plan of pruning, it would not be long before our peaches would be about as big as an English walnut. I believe in cutting the tree and keeping it cut.

Mr. Buck: I have listened to what the gentleman has said and I must disagree with him, and also with the essay of our Chairman, in this respect; I only speak of our own locality, which is hot and dry. It is said, I believe, that close pruning forces earlier crops; that does not agree with my observations, but to the contrary. You leave the tree without the use of the knife and you will get within a certain number of years a very much larger proportion of fruit than you will by pruning. Now, this high system of pruning that is advocated meets in our locality a serious objection—the tree grows out of your reach; there will be those limbs which will be loaded down with fruit; those limbs are swayed to and fro, and the fruit will be marked by the bruising of the limbs, and will be almost unsalable and unmarketable. I agree with him in reference to the vitality of the stock that the tree grows on; there is no question but what the vitality of the seedling peach is far ahead of that of any of the grafted or improved varieties, but in this day you have got to have fruit of a given kind and a given variety; you cannot go into any market and sell a miscellaneous lot of seedling fruit and receive a remunerative price for it. The canners want a yellow peach or a white peach; they want peaches of the same kind to work at the same time, because they do not work them alike and together, and a mixed variety of fruit never is salable in any market that I have ever seen yet. We prune not as short as the gentleman says; we usually start about twenty-four inches from the ground, forming a fork of three or four or five branches, and we prune as he says he has seen pruning done, but not quite as short; we do that for the sake of strengthening the fork of the tree, or the arms of the tree, as we call them; otherwise you let them grow out in its natural shape, and within a few years those limbs will be running up, and in a very hot spell the chances are that some of those branches come down and make an unhealthy tree. I have got trees on my place that are said to be nearly forty years old, and they are as good and as healthy trees as any young trees I have got; but they have been well pruned and have never been allowed to overload with fruit and break down a large limb. You can't cut off a large limb of a tree without you cover it to prevent its rotting to the core, but whether it will be injurious to the tree I cannot say. I think that modern pruning is necessary not only for the health of the tree, but for the quality of the fruit also.

A DELEGATE: Unfortunately for the people of San Diego County, as far as I know, we have been pruning most all our trees low, and I have never been able to find out yet that we are wrong. Take the orange tree, for instance, and it is not necessary to cut back like the gentleman speaks about it, in pruning the apricot and the peach; but if you let the orange tree take its natural course it runs up a high top, and it also will spread with branches clear to the very ground. Now, it is not necessary to prune much, but it is necessary to leave a good many buds, and sometimes pinch the ends off of limbs, so that in pruning the orange it is not a question of pruning high or pruning low, it is merely rubbing off or letting the ends grow out. I think for my part, I should not start the head of an orange tree higher than from two to two feet and a half. I have noticed some high pruning of orange trees in this section of California, and I have noticed those that start low, and you will find the best fruit on the lower limbs if they are started from two to three feet high. The limbs will eventually hang down until they will come very near the ground, and I have seen many orange trees that a man could get down on his knees and pick more good oranges off of them than he could off of high pruned trees with a stepladder. In fact, the orange tree will bear more good oranges, more large oranges on the lower third than it will on the upper two thirds. In reference to the apricot tree, I think it should be started low also. We find here in San Diego County that the best apricots grow on the lower branches; why it is I cannot altogether tell. We notice, also, that the best apricots grow where they have some shadow, so that by starting the tree low, and letting it run up, and, in fact, cutting it off, so that it will round up with a round head, and keeping it compact, and keeping the limbs cut back, and pinching back, so as to keep the bearing properties of the limb back, near the body of the tree, you get a strong and growing tree, you get a tree that the fruit nearly always grows in toward the center: at least you get fruit that is protected from the sun, and you get a much better quality of fruit than you can by letting them grow high and extend their limbs out a long distance.

A DELEGATE: I will inquire of the gentleman whether he ever prunes an orange tree?

A DELEGATE: I might say yes, sir. I think it is necessary on some orange trees to open them up; they grow too close; there are too many small limbs that grow on orange trees; but as for trimming the ends of the limbs I think there are very few cases where it is ever necessary to cut the end off a limb and prune it in, like you would an apricot or peach. I let them grow as far as they will in that direction upward and outward; but if they get so thick that there are so many leaves you cannot see into them you have got to open them up.

MR. SOL. RUNYON, of Courtland: I do not know that I can offer any light on this subject; I have been practicing all kinds of pruning, but for the last few years the scale bug has done the most of my pruning, and I have about come to the conclusion to let it alone, but my experience on the Sacramento River, where I have lived, is in favor of low pruning. I have killed two or three orchards by pruning too high. I have pruned very little for the last three or four years; I do a good deal as Dr. White says, let nature take its course for awhile, and I have had pretty good success; I have thinned the fruit more and trimmed less. There is a great difference of opinion in this matter, and I am not able to say what is right and what is wrong, as my experience has been unsatisfactory to myself. I think that it is the same in regard to pruning as it is in regard to scale insects; what will do in one section of the country will not do in another, and we have to learn by experience and practice in our own locality.

MR. WHITE: I am not totally opposed to budding or grafting, but it is the excess that I objected to. Now, take the Baldwin apple, and follow the history of it through the Eastern States. After a few years of its introduction it is covered with a black speck, which is the initial step of decay, and it becomes in some sections worthless. Take the Rhode Island Greening, and you find there are certain States where it was once the finest fruit of the neighborhood, and you find it is dead from the excess of budding and grafting. Take any of the old standard apples, and follow them through, and you will find the tendency is to run out and decay. The subject of the decay of popular fruit is a subject that should arrest the attention of this Convention and of all experts in horticulture. In the interior of this State, in the interior valleys of the San Joaquin, if you prune high as I do and as Mr. Cooper does you will lose your trees, you will have them sun-burned and you will have no fruit. Now the true system of pruning, be it on the coast or be it in the interior valleys, is to keep your tree in a symmetrical form, and instead of thinning out your fruit, prune your tree and you will have your fruit thinned properly to the best results; you let your tree go without pruning and the fruit will be small inferior fruit, and if your tree is going to overbear use the knife—use the knife to thin your fruit, and while you may be able to prune low in the interior you can prune high in the coast counties.

OLIVE CULTURE.

Essay by HON ELLWOOD COOPER, Santa Barbara.

This subject was very fully discussed at the Chico Convention, but so far as varieties were concerned, the conclusions were rather unsatisfactory. The numerous discouraging reports upon the Redding Picholine has disheartened those who have planted this variety, and left thousands of the young trees in the nurseries unsalable. The demand for the Mission cannot be supplied. New varieties are being imported both for oil and pickles. New planters cannot be too careful about the selection. The Mission is the only variety that has been tested in California, through a number of consecutive years, for the quality of the oil and quantity that can be produced from a given number of pounds of ripe fruit. For pickling, the demand is almost wholly for the Spanish Queen, the preference given on account of its size and beauty. It is my opinion that the pickles made from the Mission olive, once properly put upon the market, will, when their superior quality is known, supplant the Spanish Queen. The Mission being an oil olive, is richer, more delicate in flavor, and as a matter of diet far superior; consequently the growers of the Spanish Queen may find after many years of waiting that they have made a mistake. Oil making will become general throughout the State. The pickler of the Mission will find ready sale for his surplus, and such berries that are not suitable for pickling; while the Spanish Queen cannot be used for oil making. It is not an oil olive. The Mission olive, if carefully handled, will retain in the pickle all the oil. It is rich in life-giving substance. It is a freestone, leaves the seed readily, and has more pulp than a Spanish Queen of twice the size.

The Number of Trees to Plant on an Acre.—There are several different theories on this point. In a recent essay, forty feet was given as the proper distance, and is the distance advocated by the Italians, and therefore worthy of the greatest respect, being the experience of generations.

We were recommended to plant vines, vegetables, or something else between the rows. A great deal of our land is not suitable for either, therefore is it not more profitable to plant olives; or, in other words, to plant twenty feet each way, and in twelve to fifteen years, when the orchard becomes crowded, remove every other diagonal row? This would leave an orchard with the trees nearly twenty-eight feet distant and fifty-four to the acre. At twenty-five to thirty years, remove every other straight row, and we would have an orchard of twenty-seven trees to the acre and distant from each other forty feet.

This plan of thinning out would answer for many other varieties of trees, where planted too thickly. The value of the wood will more than pay the expense of thinning out.

DISCUSSION.

In answer to a question asking what varieties should be planted, etc., Mr. Cooper replied: I have stated that so many times that it is hardly necessary for me to repeat it in this place. I would refer those people respectfully to the biennial reports of 1885, 1886, 1887, and 1888, and also the proceedings of the Chico Convention, which will be published by the State Board probably within a month, ready for distribution. Those reports contain almost every phase of the olive subject, and you can get all the information that it is possible for me to give, as well as the experience of others. I have the Mission olive growing on five different kinds of soil: on black adobe, on deep sandy bottom land, on rolling stony hills (most of it soft sandstone), upon the mountains that are in the rear of my ranch, and on clay. I have them growing on the sandy loam subsoil brick clay, probably in some places twenty feet deep under the soil, which is from twelve to eighteen inches in thickness. The trees apparently do equally well in all these conditions. They grow, however, much more rapidly in the deep sandy loam, make wood much more rapidly and a tendency to grow taller, and have to be cut back at the top. The black adobe apparently gives the best oil, and the most to the certain number of pounds, and it is my opinion that it is on account of the quantity of lime contained in the deep rich black adobe soil, and that it will give more fruit of any kind, if it is possible to have the rains come in such a way that it can be properly cultivated.

Mr. Lelong: I would like to show the difference between what is the true Picholine and what has been planted as the Picholine. There are very few trees of the true Picholine planted in this State. The Picholine is of the Lucques type, of crescent shape. What is known as the California or Redding Picholine is planted throughout the State very largely and makes a sweet pickle, but it is too small for market, and for that reason not profitable to grow; there has been considerable discussion as to whether it is the true Picholine; it does not belong to that type; it belongs to the wild olive type. The name "Queen" is a commercial brand, and is given to any olive that is large, pickled for the market. The Regalis should be the real Queen.

Mr. Holmes, of Riverside: I have been growing olive trees for about thirteen years from irrigation. I have had various success with it, and I confess I do not know to-day which is the better plan, to irrigate considerably, or not at all; so far as my own experience goes, I must say, those trees on my place which had the most cultivation, the most fertilizing, and the most water, have yielded the most fruit; my experience entirely contradicts the idea that we had in the past, that the olive tree would grow anywhere without any particular cultivation, and so far as I am concerned olive growing is not a success. Whether I have had the misfortune to have Mission trees of a different variety from some others, I do not know, or whether there are some local peculiarities of climate which prevent the bearing of fruit, or whether they blossom too heavy, I am not satisfied. I am very much inclined to take the trees up; they are fine trees and beautiful as any, but last year there were but three trees had anything of a crop; those three trees bore very heavily, have yielded well for years, and they are not nearly as large as some of the others, but the orchard as a whole has never paid. I think there are some questions involved of great interest to people that are interested in the olive; it is possible that our climate, so excellent for the citrus trees and for the raisins, may lack just the quality that is needed by the olive; if it were not for the fact that sometimes we have had a marvelously fine crop from the few trees in the county, I would think perhaps it was useless for us to attempt to grow the olive there. Personally I am not satisfied either way. I would like to retain the trees because they are beautiful, and after one has worked a dozen years to raise an orchard it hurts him to dig them up, but if it had been the Navel orange I should have got off that patch a thousand dollars a year for the last three or four years, and instead of that I have got nothing.

A Delegate: I want to ask a question right here: I have heard that if you wish to propagate your tree by taking the cuttings from the bearing trees that they would bear in two years, but if the cuttings are taken from trees that have not borne that they won't bear for fifteen or twenty years and afterwards turn out to be very good trees?

Mr. Cooper: All my experience in planting has been from bearing trees. I have planted some that are two years old from the cuttings this month of April, and many of them are full of bloom, showing that they will bear fruit this year. I have had no experience in planting cuttings taken from non-bearing trees.

Mr. Peck: Way back in the sixties I stuck three olive cuttings in the ground three miles from Auburn; those cuttings grew and came into bearing very early and have borne every year since a large, fine olive. They have been most thoroughly irrigated every year. They are the Mission olive.

A Delegate: I would like to ask in regard to the cuttings. I planted quite a number of Mission this year, and I notice the shoots coming out in places are bunched, perhaps half a dozen or a dozen almost. Do you think it would be advisable to take off part of those or let them all remain a year or two?

Mr. Cooper: That is a very important question; cuttings planted must not be disturbed; everything that shoots out from the cutting is required to make roots; nothing should be broken off, everything, all the brush should be let grow. The second year, probably about this time or a little earlier, I examine these shoots, that may be a dozen, or may be four or five, a number of them vieing with each other to get up about the same height, and select the one that according to my view would probably make the best tree. I pinch the tops off the others not disturbing them in any other way, forcing as much as possible the growth into the shoot selected for the future tree until after July, so that at the end of July or August, when the tree has made its most vigorous growth, all the power of the rainfall will be pretty much absorbed in this rapid growth of the roots; then you can afford to take part of the shoots off, not many, but probably two or three that are nearest the size of the future tree, and let all the others alone. It don't matter how much brush you get or how many lateral branches, unless they make wood don't disturb them; you will find that the following year, the third year, that the future tree, the one selected to make the trunk, will throw out great numbers of lateral branches from the size of a pencil to the size of your little finger; they run out a great distance and must never be disturbed, for those branches are necessary to cultivate a trunk; they must not be destroyed, for if they are destroyed the stem will run up too high, bend over, and prevent the growth of the root. This process of pruning must be carried on for three or four years before you establish a top at all. Let everything grow, because without a root you cannot grow a top. The more you let grow the larger will be the top and the larger will be the tree.

Mr. Heath: I desire to give a little of my experience in Santa Barbara County, with regard to the planting of the cuttings of the olive. Your olive stock, when placed in the nursery or in your orchard where the tree is to stand, will not always sprout the first year. I have seen cuttings planted on good land, on good moist soil, that failed to produce any bud for three years, while part of the nursery was producing buds, and making tops in the same rows—they remained apparently dormant for three years, some sprouting the second, and some the third year. Those that had made no growth the third year were, at five years of age, as vigorous as the one that started the first year. You need not be at all alarmed, so that if you plant your cuttings and they do not sprout, all you have got to do is to see whether it remains green; do not disturb them; do not be alarmed if they do not sprout the first and second year, in five years you will have a vigorous tree.

Mr. Kimball: I think that is under entirely favorable conditions. I know in 1872 I planted cuttings in March that were taken off in February and exposed until March when planted. They never showed the intention of growth until the fifth year, and in August, after the completion of the fifth, they became as vigorous and as strong plants as there were in the orchard. My practice in planting olive cuttings—of which I have a good many—is to cut them not longer than ten inches, if they are more than three fourths of an inch in diameter. I prefer a cutting that is three fourths of an inch, or at least half an inch in diameter, to any size I have used. I sent to San Francisco, at the meeting of the Grand Army two years ago last August, two trees grown from cuttings, that were two years old in March—one of them an inch and a half in diameter, eleven feet high, and loaded with fruit, until the lower limbs would touch the ground. After the Grand Army meeting I gave them to Adolph Sutro for his garden.

IRRIGATION AND PRODUCTION OF WATER SOURCES.

Essay by L. M. Holt, San Bernardino.

Mr. President, Ladies and Gentlemen of the State Fruit Growers' Convention: Water is essential to plant life, and whenever too much water or too little water is used the highest state of development is not reached. One plant differs from another in the amount of water necessary to the best possible growth and development, but each variety of plant life must have the amount of moisture best suited to its peculiar needs in order to make the best possible growth—no more, no less.

There are two methods of applying water for the benefit of trees, vines, and growing crops. One is natural and the other is artificial.

In all departments of domestic economy nature furnishes the raw material and man utilizes it.

Lightning is the active development of electricity by nature. As such it is of little value to man; but this same element, controlled, has revolutionized and is revolutionizing the world.

Over a great portion of the earth's surface the application of rainfall to the promotion of plant life is so irregular that the artificial application of water has been reduced to a system and a science. In fact, in no part of the world is the rainfall so distributed that the best results from agricultural and horticultural pursuits are obtained except by means of irrigation.

In the great Northwestern States the lack of a proper amount of rain, or a little too much rain at the proper time, annually reduces the yield of grain and other crops. And while there are occasional tracts of land on which, in a given season, the maximum yield of grain may be obtained, yet such maximum yield is the exception to the general rule.

In Florida the annual rainfall exceeds fifty inches, or an average of an inch per week—over four inches per month. In San Bernardino the average rainfall for January, the wettest month in the year, has been only three inches. Thus we find that the average wettest month in San Bernardino is only about two thirds the average monthly rainfall of Florida throughout the entire year.

It would seem that if California could have its winter rainfall extended throughout the entire season that irrigation here would not be a necessity, and yet the ablest horticulturists of Florida are discussing the proposition of establishing irrigation works in that State, where a half more water falls during each month in summer and winter than falls here in the wettest month of winter, and they assign as a reason that because they cannot have their rainfall at just such periods as they need it the crops are injured and the best results cannot be obtained.

Whether it pays to irrigate depends, of course, upon circumstances.

If it were practical to irrigate the crops in Iowa and Illinois, it would not, as a rule, pay to do so.

A wheat field, for instance, in Iowa will yield fifteen bushels of wheat per acre in a good season, and this is reduced to ten or twelve bushels in a poor year, or increased to twenty bushels under favorable circumstances. The wheat sells at $1 a bushel when times are good. The difference between a poor crop and a fair crop is only, say, five bushels, or $5, from which the extra expense of harvesting, threshing, and marketing must be deducted. If the irrigation of a field of wheat would increase the yield from ten to fifteen bushels per acre, it would not pay to so apply the water, for the expense would be more than the increase of crop. The same rule would apply to nearly all other crops in that section of country, except it be to small fruits and vegetables.

In this State we have certain crops which cannot be irrigated, because the expense is greater than the increased income. We sow our small grains in fall and winter, and trust to Providence for bountiful rains and a bountiful harvest, or content ourselves the best we can with a light rainfall and a light harvest. In some sections of the upper San Joaquin Valley, where the conditions of soil and water and its application are favorable, it has been found to pay to irrigate winter wheat and produce a crop that would yield from forty to fifty bushels per acre; but even in those sections wheat culture is being superseded by fruit culture, because the financial results of fruit culture are more satisfactory.

The first impulse of a man when he arrives in Southern California from a rainy section of country is to exclaim: "What a country this would be if it only rained here in summer!" After he has been here a few years his exclamation is: "How fortunate it is that it does not rain here in the summer season!"

There are two reasons why this last proposition is true. The first is one of health, and the other is one of wealth.

With summer rains Southern California would have all the bad points of a Florida summer climate, with its malaria, yellow fever, and troublesome insects, which find a genial home in a moist climate.

With summer rains here it would be impossible for us to produce the superior oranges for which the interior valleys of this southern country are now noted.

This may seem like a strange statement; but the fact stares us squarely in the face that the markets of New York City, Chicago, Boston, and other eastern cities declare unanimously that no section of the world sends to those markets as good an orange as the Riverside Washington Navel, as produced in the interior valleys of Southern California.

That superior orange is not the result of superior soil, but of superior climate, of which the rainless, dry summer is the principal factor.

Is irrigation a burden? Let us see. The grain crops of the Western States are, as a rule, decreased in amount 20 per cent by irregular rainfall from what they would be if the rains came in quantity and time to do the most good. This is a safe estimate. Apply the same rule to our orchards, and what is the result? On our ordinary peach and apricot orchards that yield, say, only $100 an acre, a loss of 20 per cent means $20 an acre. This is saved by irrigation at a cost of half the amount, or less, while in the orange orchard, which yields from $500 an acre upwards, a loss of 20 per cent means a loss of from $125 per acre and upwards; and this saved by irrigation.

We all know what effect a drought has on a fruit orchard. Visit the orange orchard of the careless owner who skipped an irrigation last summer, in August, and you will find a small crop of small oranges that sell for a small price, which is in entire keeping with the small amount of judgment exercised in caring for the orchard. This skipping an irrigation is on a par with the non-irrigated sections when it forgot to rain for two months, and the result is the same also.

It is impossible to complete this subject in a single paper, but at the risk of too great length I desire to call attention briefly to increased water supply, both artificial and natural.

A few years ago the most enthusiastic boomer of Southern California could not hope that one half or one quarter of the arable land of this section would ever be brought under cultivation, because of the lack of water. To-day I feel safe in predicting that the time is not far distant when practically every foot of arable land in Southern California will be brought under successful cultivation, water for irrigation having been found where irrigation was necessary.

The water supply during the past few years has been materially increased, and in many places more than doubled by artificial means, and this development is going on to-day at a rapid rate.

First—The natural flow is being saved by the construction of conduits (pipes and cement canals), which save all the water in the streams and put it where it will do the most good.

Second—The natural flow of our streams is being increased by running tunnels under the bed of the streams to take the underflow, which otherwise is lost.

Third—Artesian wells are being sunk in large numbers and large irrigation systems are being formed, and an abundance of water is being obtained from this one source alone, which is adding millions to our wealth and thousands to our population.

Fourth—Storage reservoirs are being successfully built. There are at present three large reservoirs completed and filled with water. The first attempt was the Bear Valley reservoir in San Bernardino County. It is a grand success, and no one can look into the future far enough to see the vast acreage that reservoir will eventually irrigate. The Cuyamaca reservoir and the Sweetwater reservoir in San Diego County were next completed, both of which are more than meeting the expectations of their promoters. The Hemet Lake reservoir near San Jacinto and the San Luis Rey reservoir are both in process of construction, and others will follow. This shows the artificial increase of irrigating water.

While man is at work helping himself, nature is also at work to prove the truth of the old adage that "God helps those who help themselves." And while man is at work increasing the water supply by artificial means, nature is at work sending us an increased rainfall, and this increased annual rainfall is the result of man's work.

It is a well known fact that in the State of Nebraska the rainfall has very materially increased during the past thirty years, and that to-day good crops can be raised where before nothing could be raised at all. The Government records show this marked increase of rainfall, since the settlement of that country. This increase is traced to two causes. One is the establishment of railroads, which have an effect upon the electrical conditions, and the other is the planting of trees and breaking up the surface of the ground and thus gradually replacing the barren plains with green verdure.

The same rules apply to Southern California, and let us see what the result is. San Bernardino has a record of the rainfall for the past nineteen years. A study of the table shows the average rainfall for the several months during that period of nineteen years, to be as follows:

MONTHS.	Inches.
July	.03
August	.07
September	.05
October	.43
November	1.68
December	2.99
January	3.36
February	3.16
March	2.49
April	1.64
May	.46
June	.08

The first of February appears to be about the middle of the rainy season, as 8.61 inches fell before that time and 7.83 inches after.

Let us divide this period of nineteen years into two sections of nine years each, leaving out of count the present unfinished season, and then make a comparison of rainfall during the first section with that of the other.

During the first nine years of the nineteen-year period the rainfall averaged 15.20 inches each year, and during the next period of nine years the average annual rainfall was 17.44 inches—an increase of 2.24 inches. This increase is not very much, and yet it is an increase of nearly 15 per cent, and enough to frequently turn failure into success.

This increased rainfall becomes more valuable when we show that it is to be found in the spring of the year when most needed. During the first nine years we find the average rainfall in March 1.07 inches, while in the second nine years it is 3.50 inches, while the rainfall for April increases from .67 of an inch to 2.64 inches, and in May the increase has been from .23 of an inch to .68 of an inch.

This period of comparison is not long enough to give conclusive results, still the records point very strongly to the theory that as the country settles up the rainfall increases and comes at periods when it is most acceptable and does the most good.

It is well enough to note also in this connection that the rainfall of October has not increased, while that of November has been somewhat less. The principal increase of rainfall appears to have been during the months of March, April, and May.

If man continues to develop water by means of tunnels and artesian wells and to store the surplus water from the winter rains in vast reservoirs, to be used in irrigating the plains during the dry season, and if nature, becoming enthusiastic over the successful works of man, sends down additional rainfall at a time when it does the most good, surely the time is not far distant when every arable acre of Southern California will be teeming with life and activity; every ten-acre tract will contain a beautiful home, and a contented, independent family; each neighborhood will build and patronize its public school; each settlement will contain its church building with its spire pointing heavenward; each valley will contain its village and business houses; each county will have its commercial center, and Southern California will have a larger population to the square mile than any other agricultural section of the globe; and then the people will verily believe that irrigation is cheaper than rain.

FRUIT PACKING.

Remarks by Hon. L. W. Buck, Vacaville.

I have prepared no essay on the subject of fruit packing, for the reason that I thought that what I had to say could be better said by word of mouth, perhaps in response to questions that might be asked. I will refer only to deciduous fruits, as I have had no experience with the citrus fruits of the State of California. I have had some experience in the handling, the packing, and shipping of the deciduous fruits of our State, and to any one that has been all over the territory, and seen the amount of fruit lands that are already planted, or that may be planted, they may well say, "What shall we and what can we do with the fruit to make it profitable to the grower?" We have, in my judgment, three great sources of consumption: first, canning; second, drying; and third, shipping to eastern points, or where they have not the like of our fruit. Of the first it is not for me to speak; the canning industry of the State we all know is a very large one; there is hardly a fruit district in the State that has not its local canneries, to say nothing of the large canneries that center in and around San Francisco. As to drying, you are probably as well posted as I am in the drying of fruit. The shipping of fruits to outside markets is to some comparatively new in this State. The northern, as you Southern Californians call it, or as we call it, the central part of the State, has hitherto shipped the bulk of the deciduous fruits that have gone East. There are many localities that from point of location alone are virtually deprived of the conveyances for shipping; and we of Central California have to face a high freight to eastern markets, which, coupled with the uncertainty of the market and the chance of delaying transportation, at many times makes the business a very hazardous one, and it has not always resulted in pecuniary advantage, I assure you. There are several varieties of fruit that are comparatively safe to ship; the pear, the Bartlett pear in its season, and the fall and winter pears are shipped with almost as much certainty of a return, or almost as much certainty of arrival in condition, as a carload of wheat. Until three years ago there had never been any quantity of peaches shipped from California to the East; three years ago there was quite a large quantity, two years ago a much larger quantity, and one year ago a very much larger quantity still, and up to a certain time, and that the time when the eastern peach crop came into the eastern markets, our peaches fared very well indeed, and as a rule brought fair prices in the East. The shipments of peaches were continued too long by some, and did not meet with that return they should considering the quality of the fruit that was sent over there.

Last year I was East for two months, and in all of the large cities of the East I saw California fruit in all its phases, and I saw eastern fruit that we had to sell in competition with. The California fruit has not only become a luxury, but it has become a necessity in all of the large cities of the East. The fruit-stand depends upon the California peach, pear, plum, and grape to ornament the stand and make it look inviting. To be sure the most of them had in view their own domestic fruit with them; but I tell you that that domestic fruit bears no comparison in appearance to ours; and when it arrives there in good condition it will and does sell. The outlook for eastern shipments, I think, is encouraging. We need a competing line of railroads, and when we get that I believe we will get a rate of freight that will enable us where we ship one car now to ship fifty. For if peaches could be laid down in the City of Chicago, and all equivalent points, and sold at $1 a box, I do not believe that there is any limit to the amount that can be sold. Last year the California Fruit Union alone sold in the City of Chicago about five thousand boxes per day for a few days; and, besides that, there were several other shippers that would probably make the amount sold, some days, over six thousand boxes, or in the neighborhood of seven carloads. That amount for last year perhaps was pretty large, but at the same time the prices were fairly well maintained even with that amount. Our peaches were shipped to New York and Boston, and the only question of price in those points up to the first few days of August was the condition of arrival. If they arrived in good condition they sold readily and at good paying prices to the shipper. After that time you are treading on dangerous ground to ship California peaches to New York and Boston.

Now, there is a great deal that can be said in reference to the condition of fruit, but that can be learned best by experience. Peaches should be picked when they are well grown, and as nearly ripe as possible, but without showing any symptoms of softness at all; they should be perfectly firm, and great care should be exercised to exclude a wormy or defective piece of fruit. I saw a great many boxes of peaches where the sale was greatly injured by having one wormy peach put on the face of the box; and too much care cannot be exercised in the sorting of fruit. The same thing is true of the pears; I do not care much how green a Bartlett pear is shipped from here, if it has a worm in it, it is ripe when it arrives in Chicago or any other eastern point, and not only ripe, but it is so ripe that it spoils the balance of those that are in the box, from the fact that the mere seeing one ripe pear in it they think that they are all ripe, and any fruit to bring a good price in the East must not only arrive at the point of destination in good condition, but it must have from one to three days' life after it gets there, as neither Chicago, Minneapolis, St. Paul, nor St. Louis, or any of these large cities, can consume all of the fruit shipped to those points; it must be shipped from those to the other consuming points, for which they are the centers of distribution.

Plums sell well and are good shipping fruit, especially the dark varieties; the white or light-colored plums sell only in very small quantities at a paying price. Grapes sell generally very well, if arriving there in good condition; last year a great percentage of the grapes shipped from California arrived in very poor or only fair condition; and while we are shipping grapes from California there is none of those markets that are not supplied with their own domestic grapes. In fact, Chicago had grapes from the Southern States before it had any from California last year, and they look well, but at the same time do not sell as well as California grapes do. There are none of the summer varieties of pears that bear any comparison to the Bartlett; the later varieties come in after their Bartletts are gone, and have sold as well, or better, than the Bartletts.

REPORT OF COMMITTEE ON EXHIBITION.

To the President and Members of the Eleventh State Fruit Growers' Convention, assembled at National City, San Diego County, on the sixteenth day of April, 1889:

LADIES AND GENTLEMEN: Your committee to whom was given the duty of examining and reporting upon the fruit and agricultural display held in connection with your Convention, beg leave respectfully to report:

We would call especial attention to the general arrangement and decorations of the Assembly Hall and exhibition rooms. The advantages in decorative work to be derived from the great variety of floral products have been fully utilized by our resident friends. The cypress and the palm which grow side by side in our State have been arranged in juxtaposition, the attractive features of each being fully preserved.

The assortment and quantity of flowers used in decorations would be marvelous to any but Californians. Just here the thought occurs, that in the prodigality of Flora's treasures here, we all too little value what we have. Avenues of callas and roses possess for us little of the charm they have for our eastern friends. Nothing speaks in louder tones of the climatic advantages of California—all California—than the profusion of flowers in our gardens. We are so accustomed to them that we little prize them. If this is true of cultivated flowers, it is hardly a matter of wonder that our beautiful wild flowers are neglected. These gems that carpet our hillsides and bespangle our valleys are, however, appreciated for their worth abroad. The seed catalogues of eastern and European nurserymen contain long lists of native California flowers.

The attractive pyramid of wild flowers from Chula Vista, made by Mrs. R. S. Harris and exhibited near the entrance of the hall, has received deserved attention and furnishes the text for what we have said. Mrs. Annie Russ Johnson, as Chairman of the Committee on Floral Display, has been unremitting in her labors, ably assisted by Mrs. T. J. Swayne, Mrs. John Boal, Mrs. Alberta Brown, Miss Maria Steele, Mrs. F. Copeland, Mrs. Frank A. Kimball, Miss Ella Gordon, Miss Jessie Gordon, Mrs. Jennie Crenshaw, Mrs. C. J. Lord, Miss Lizzie Webb, Miss Carrie Floyd, Miss Lizzie Floyd, and Mrs. E. Steele. All these ladies have worked "manfully" and are deserving the thanks of their guests for the

pleasure their work has given. Among the contributors of flowers and floral designs we feel compelled to call especial attention to Mrs. Crenshaw, whose artistically arranged cornucopia of margueritas, filled to overflowing with luscious fruits, has been a constant vision of loveliness in our assembly hall. The American flag, made by Mrs. Boal, is one of the prettiest pieces of floral work we have seen. The old way of constructing, in stiff, straight lines, has given place to the more natural and artistic form of drapery. Miss Maria Steele, Mrs. E. Steele, Mrs. Dr. Smith, and Mrs. Annie McKay Lansing have prepared beautiful floral baskets. Among the other contributors we notice the names of the Coronado Beach Company, the National City scholars, Mrs. Flora Kimball, Mrs. T. J. Swayne, Mrs. Seiberlick, Mrs. J. P. Jones, Mrs. O. E. M. Howard, Mr. Thomas Walker, Mrs. J. G. Griffin, Mrs. Frank A. Kimball, Mrs. Annie Russ Johnson, Mrs. Barber, Mrs. J. D. O'Connell, Mrs. Griffith, Mrs. Dr. Risdon, Mrs. George W. Chase, Miss Laura Kimball, Mrs. Floyd, Mrs. Aylsworth, Mrs. Eva Parsons, Mrs. J. Adams, Mr. W. W. Whitney, Mr. Thieben, and Mr. E. S. Babcock, Jr.

The decorations of the assembly and exhibition halls under the personal direction of Mr. and Mrs. Warren C. Kimball, and almost entirely executed by Mr. F. Copeland, are deserving of especial mention. Mrs. Warren C. Kimball exhibits a basket made of carded cotton, which is particularly interesting, from the fact that the cotton is the seventh successive annual crop from the same plant. We know of no other section of the world where such results can be obtained.

In glancing over the floral decorations one thought suggests itself to your committee. The advance in artistic home culture is nowhere more fully shown than in the arrangement of flowers. The old stiff compact bouquet, in which each individual flower was jammed into place in an attempt to get as many flowers as possible into a given space, has given way to a looseness and freedom of arrangement, in which the individual characteristics of each variety are shown to the best advantage. This is especially woman's work, and as such opens avenues for woman's profitable and pleasant employment, and to that extent should excite the attention of every horticulturist and good citizen.

The display of citrus and deciduous fruits and other products of the soil is a very creditable one, and yet such exhibits have become so common to residents of this State that our people do not appreciate the wonderful combination of productiveness which places oranges and apples, lemons and turnips, cotton and wheat, side by side on exhibition in the same hall, grown on the same soil, in the same climate, and shown at a season of the year when the great bulk of the country is just emerging from a six months' sleep, during which all nature is quiet, but man must make the season one grand struggle for life.

It is the stranger who looks upon this exhibit with wonder and admiration, while the old settler views it with a critic's eye, and gathers information from its eloquent sermons; for the statements made by this exhibit are not contradicted by the next exhibit which occupies the floor.

The lessons taught by this collection should be carefully studied, for by this process alone can anything like perfection be reached.

The exhibition of oranges is a very fine one, and the quality at this season of the year is much better than the fruit exhibited earlier in the season.

There is a marked difference between oranges grown near the coast and those produced in the interior. Along the coast the orange trees blossom at more irregular intervals than they do in the interior, hence the fruit ripens during a longer period of the season. The moist and cool atmosphere of the coast valleys also delays the ripening season, so that the oranges do not, as a whole, ripen so early, but extend further into the summer than the crop does in the more interior valleys. This state of affairs has its advantages and its disadvantages; the principal advantage being a longer season in which to market the fruit.

This report would be too bulky were we to mention the large number of exhibitors and describe their exhibits, but we say here, that the fine collection of oranges and lemons by Mr. J. S. Harvey, of Jamul Valley, is the largest exhibit in the hall, and illustrates not only the fine quality of fruits raised in this section, but it also shows a very commendable and enterprising spirit in exhibiting these fruits, so that the world may know what this county will produce.

The excellent exhibit of oranges in plates, and packed by E. P. Fowler, of Olivewood Orchard, is especially noteworthy.

Among the other exhibitors of citrus fruits we may particularly mention T. J. Swayne, Jas. Fleming, Kellogg & Litchfield, and C. R. Williams, of Paradise Valley; Major Levi Chase and H. T. Christian, of El Cajon Valley; Mrs. M. A. Stiles and J. V. Stewart, of Spring Valley; H. L. Story, of Dell Terrace; F. F. Keene, of Sweetland; J. L. Griffin, of Chula Vista; F. W. Bartlett, L. R. Stiles, E. J. Johnson, V. C. Rechie, A. M. Peters, and G. L. McWalter, of Fallbrook; W. W. Whitney, J. C. Frisbie, F. E. Johnson, and G. W. Davis, of Sunnyside; H. M. Higgins, of Bonnie Brae; G. L. Kimball, N. J. McKay, W. C. Kimball, O. P. H. Foraker, E. Aylsworth, G. H. Parsons, Mrs. H. E. Blossom, P. T. Griffith, J. A. Rice, of National City; F. Schulenberg and High Bros., of South Chollas Valley; Agua Tibia Ranch; J. S. Paylor, of Del Mar; G. W. Garcelon, Hon. E. W. Holmes, M. B. Ogden, E. R. Skelley, and Griffin & Skelley, of Riverside; Chas. Hale, of Santa Barbara County.

The orange industry has been placed on so solid a foundation that no one for a moment questions the advisability of planting an orange grove; but such is not the case with the lemon, and hence this fruit needs more careful study and attention.

The lessons to be learned from this exhibit on the culture of the lemon are many and valuable. Here we find the same peculiarity of late ripening of the lemon in the coast valleys that we find in the orange, only in a more marked degree, and this late ripening is a decided advantage, except that the lemon which hangs on the tree all winter is inclined to become overgrown and have a coarse rind. The season for marketing the lemon to best advantage is during the hot summer months of June, July, and August; and if the lemon can be picked, fully matured, by the first of May, and then sweated and prepared for market by June or July, much labor and expense would be saved.

There is in the exhibition a small collection of lemons grown by G. W. Garcelon and Hon. E. W. Holmes, of Riverside, which deserve attention for the lessons they teach. The former have been picked five months and the latter four months. The fruit is medium size, not overgrown at all, is perfectly ripe, of course, and is in a perfect state of preservation, while the rind is soft and pliable. In short, the fruit is in a perfect marketable condition, and the expert could not detect this fruit from the most perfect samples imported from Europe. It is this question of preparing the lemon for market that must demand our attention. If this question cannot be solved, lemon culture in California will not be a success.

In Riverside the lemon is sufficiently matured to pick in November and December. By being picked at this time the cold weather is avoided and the rind does not have a chance to thicken and become rough. The lemon is first put into sweat boxes in an open shed, free from moisture, and allowed to cure for a month or six weeks. The fruit is then placed on trays, only a few layers deep, in a large, close, dark, storage room, and there left for six months, to ripen, mature, and get ready for the market.

Mr. Garcelon has been experimenting with the process for several years, and has so perfected his plans that last season he put up a large packing house, for the storage of lemons only. He bought the bulk of the Riverside crop this season, and in the course of two or three months from now the experiment on a large scale will have been tried. If it proves successful, as all who have watched it believe it will, the lemon culture problem will have been solved, and California will supply the lemon market of the United States just as surely as it is rapidly supplying the orange, and more particularly the raisin markets of the country.

The largest and finest exhibit of lemons comes from the ranch of H. M. Higgins, on the Sweetwater Valley mesa. It consists of seedling lemons and the Bonnie Brae, a very thin skinned, juicy fruit of fine qualities, possessing many of the properties of the lime. The varieties of lemon now recognized as taking the lead are the Eureka and Lisbon. These are the most widely planted. The lemon of Genoa and several other varieties are good, but have not attracted so universal attention.

The display of apples is, owing to the season, necessarily small, and the number of exhibitors is small. We find upon exhibition Ben Davis, Yellow Bellflower, Spitzenberg, and Newtown Pippin, varieties grown at an elevation of four thousand four hundred feet above sea level, by Mr. Chester Gunn, of Julian, in San Diego County, and we have no hesitancy in saying, after taking into consideration the lateness of the season, and the size, appearance, and flavor of the four varieties of apples named, that they cannot be excelled upon the Pacific Coast. This excellent display brings to mind the fact that in fruit culture in California latitude cuts but little figure. Hundreds of miles north of where the orange can be grown on the Atlantic seaboard we are growing this fruit successfully in the extreme southern part of California; and not only is this the fact but for additional hundreds of miles still further northward on this coast this fruit thrives and bears abundantly its luscious crops in favored localities, and the reverse is true. On the Atlantic seaboard the apple does not do well except on higher latitudes, while on the Pacific slope its domain stretches far to the southward, not only to the Mexican boundary line but far below. In no other part of the world can you find the apple and the orange growing side by side. There are but few extreme cases between which range all the fruits of temperate and semi-tropical regions.

Jos. Sexton, of Santa Barbara, and T. J. Swayne, of Paradise Valley, exhibit the Cherimoyer, and H. T. Christian, of El Cajon, exhibits the Borneo citron. Several fine displays of loquats and one of Japanese persimmons, from El Cajon, are displayed.

These are suggestions of new horticultural fields awaiting conquest, and to us new varieties of fruits to be generally introduced. The success of the loquat and the Japanese persimmon during late years has been a gain to us. Let us stretch out our hands after new things, and through thorough experimental work in all sections of the State prove what other fruits we can cultivate with profit as well as in what sections they will thrive the best.

The collection of olives and colored illustrations of this fruit by Mr. B. M. Lelong, Secretary of the State Board of Horticulture, is an interesting feature which must not be overlooked. The importance of such illustrative displays cannot be too highly commended.

There are in the hall several good exhibits of strawberries of goodly proportions. That of Thomas Walker it would be difficult to excel in any portion of the State at any season of the year.

The display of vegetables is large and varied, and as these are all from the coast region of San Diego County they show the adaptability of this section to the production of these crops. We regret not seeing specimens of the sugar beet; but as a quantity of its seed has been distributed in the county we shall watch with interest the success of its culture.

The exhibit of native grasses and forage plants is large and interesting, not only as regards variety but growth. Wild oats from the mesas are noteworthy. The displays of grain, wheat, barley, oats, etc., are exceptionally creditable.

Several nurserymen exhibit fine collections of growing trees and plants, all of which should receive mention did not the length of this report preclude such specializing. Under this head comes the Australian silk tree, exhibited by Thomas Chase, of South Chollas Valley.

The exhibition of ornamental trees from the Ocean Side Nursery, grown without irrigation, is interesting.

W. F. Brill makes an interesting exhibit of Betsinger's (Queen of the World) combined paper box for comb honey, and sections and comb foundation. To all bee men this is interesting and valuable. The neatness of packing commends this invention.

The display of raisins is very fine, although they do not do the section justice, owing to early rains which interfered with the finest pack. Craig (3), Shaw (2), and Mosher (1), show fine samples of dried fruit.

The excellent exhibition of thirty-four varieties of jellies, made by Mrs. Lizzie Fleming, is one of the greatest attractions of the entire display. This example of the thrifty housewife's labor teaches a lesson of possible prosperity. The manufacture of domestic jellies should be encouraged. When these are put up in uniform packages there is no reason why they should not command a good sale and materially help to increase the income from the farm. In appearance and quality the jellies made by Mrs. Fleming are without equal.

Frank A. Kimball, of National City, exhibits an exceedingly attractive pyramid of his excellent olive oil and pickled olives. The taste shown in arrangement is a fitting compliment to the character and excellence of the product.

Looking over the varied and complete exhibit we are impressed with one idea—the great fundamental lesson taught by this display, and that is a lesson of progress, of steady advancement, step by step, of painstaking efforts and a proportionate successful result. The motto of the fruit grower is and must continue to be "Onward."

In closing our report, which in some respects may be considered too lengthy, but which is all too brief to do the subjects and exhibitors fair justice, we desire to especially call attention to the importance of such exhibitions as this as educators. So great is the extent of our State, and so varied are its climatic features, its soil peculiarities, and its local characteristics, and so multiform and different are their effects upon horticultural products, that such exhibitions, on a broad scale, are an absolute necessity.

Your committee has examined fruits presented in the hall, which, while of the same varieties, are so distinct in their markings and characteristic features from the same varieties grown in other parts of the State, as to be almost mistaken for other varieties. This suggests the thought that there should be in the State, maintained under the auspices of the State Board of Horticulture, a permanent exhibition of fruit and fruit products. Such an exhibition, however, should not be limited to these alone, but should include everything relating to horticulture, both in this State and abroad. We would refer to the valuable set of casts of apples made for the Horticultural Society of Iowa by Colonel Brackett, as an example. The perishable nature of fruits precludes the idea of permanency in their exhibition, except as they are prepared especially for the purpose. With a set of accurately made and colored casts this objection is overcome, while at the same time it does not preclude the exhibition of fresh fruits as well.

The collection of olives and colored sketches of this and other fruits, shown by our able Secretary, is another example of what such an exhibition should contain, as it is also a strong argument in favor of its importance. We would suggest that this subject should be brought up at our next meeting and fully discussed, and that those who have had experience in these matters should be called upon for papers, in order that a proper plan of action, looking toward the establishment of such an exhibition of fruits and fruit products, as well as their cultivation, treatment, and marketing, can be established. We think there is no question of the value and interest of such a museum as could be thus formed, as it would show by ocular demonstration the methods and results of fruit culture, and the extent and importance of horticultural development in the world's great fruit country, California.

All of which, with its many imperfections of omission, is respectfully submitted.

L. M. HOLT,
CHARLES B. TERRELL,
H. C. FORD,
A. F. WHITE,
I. H. THOMAS,
Committee.

ADOPTION OF REPORT.

On motion, the report of the Exhibit Committee was adopted unanimously.

THE ENGLISH WALNUT.

Essay by HON. RUSSELL HEATH, Carpenteria.

Having been invited by the State Board of Horticulture several times to give my views on the English walnut, so called, and its culture, I have consented to do so with reluctance, believing that others could do it much better than myself.

I must preface by saying that when I commenced the culture of the nut, in 1858, I was profoundly ignorant on the subject, but believed there was a future in its cultivation that would be not only profitable to whoever engaged in it, but would add something to the development of the great resources of our new home. I have not been disappointed in my expectations. They have been more than realized.

Commencing with the cultivation of many of the other fruits and nuts now profitably cultivated in California, I gradually came to the conclusion that it would be better to make a specialty of some one thing in preference to the cultivation of many.

I selected the walnut as my specialty, although I have on my place many of the other fruits. I hope it will not be considered outside of the question allotted to me if I give some of my opinions on the profit of fruit culture in California. Most persons, when they commence this industry, make up their minds that they must have everything on their place. This is a laudable desire. I have done it myself, but I am firmly convinced it is better to have a specialty, and turn your energies to the thorough development of one or two kinds of fruit, if the desire is to make money. I do not desire to be understood as saying that the walnut is the most profitable tree; there is money in the cultivation of all of our fruits. What I desire to impress upon the minds of fruit growers is that a thorough system is necessary to success. Trees and vines cannot be planted and neglected and remain profitable. Anything that is worth doing is worth doing well. Almost all of our fruits require a different kind of treatment and handling. With too many irons in the fire some are apt to burn, and, in the burning, your fingers are apt to come in contact with an unpleasant heat.

Now, for the walnut. This fruit has various names. By some it is called the *English walnut*, by others the *Madeira nut* and *Naples walnut*. It takes these numerous names from the different locations where it is cultivated. It really is of *Persian* origin, and ought to be distinguished by that name, and that only. It is said to be true to its seed when planted, and I believe it is, although in the planting of great quantities of seed the fruit may be somewhat different; that is, the shell may be harder or softer than the nut planted, but the kernel remains the same in flavor; in that there is no difference. The soft and medium shell nuts (and we have no hard shells) have their advocates, and much may be said concerning them; some cultivators preferring one variety, and some another. Upon that question I do not desire to enter, but simply say I have both varieties, and after years of experience I have discontinued the planting of any variety but the medium shell. In Persia the tree comes in bearing at eight years from the planting of the seed. In Italy, Spain, and the Island of Madeira, in about sixteen years; in France, in the southern part, eighteen; in England, in twenty-four; in California, eight years, the same as in Persia. So, I take it, the southern part of this State is nearest its home. Some cultivators claim that trees have produced younger than eight years from the seed. That is not my experience. If it is true, and I am sure it is, we beat its *native home*, and this adds one more laurel to California's fame in fruit culture. In the cultivation of this fruit, my advice would be, get your trees from the seed or seedlings, in preference to grafted or budded trees. Not much can be gained by grafting or budding without you desire to change the variety, as the tree comes in bearing as soon as its size could possibly make it profitable. Much has been written about the localities and soil best adapted to the planting of the walnut, some asserting that they will grow anywhere—on rocky and uninviting hillsides, on stiff clay, and adobe lands—any place is good enough for the walnut. I will admit they are a hardy tree. You can rear a pig on sour skimmed milk, but will it not do better on more nutritious food? The walnut should be planted, for profit and best results, on deep, rich loam, with no hardpan, stiff clay, or impenetrable soil nearer than twelve feet. I would select locations naturally moist in preference to land requiring irrigation. A temperature of 60 to 80 degrees in summer, I regard as more favorable than hotter localities, although they thrive and are profitable in much hotter places. I have adopted for planting, forty feet apart, and this distance will do for a hundred years, with judicious pruning. As to their age, I can only say they are a hardy long-lived tree, like the oak, and ought to produce fruit in abundance for at least a thousand years. In handling the fruit, I cure in dryhouses by artificial heat, heating sufficient to evaporate the water, and set the oil of the nut. When this is done the nuts will keep sweet for an indefinite time. I have kept them as an experiment in my storehouse, which is of concrete, for five years, and at the end of that time they were as sweet as when first cured.

With my facilities I cure them in about eight hours. In preparing them for market, I have a washing apparatus, invented by Mr. Ellwood Cooper, President of this Convention, which I use if the nuts are discolored, as they often are by coming in contact with leaves or shucks when there is dew or rain. Directly after washing, they are thoroughly dried and cured in the drying-house.

I regret to say some purchasers desire the nuts bleached, to give them a nice, bright appearance, which is done with sulphur and some other substances. It is hardly necessary to say that I disapprove of this method of preparing the fruit, as it cannot be accomplished without affecting the keeping quality, as well as the taste of fruit.

JAPANESE NUT AND CAMPHOR TREES.

Essay by H. H. BERGER, San Francisco.

The value of a plantation of nut trees is getting to be more and more appreciated in our State, and in consequence the demand for new and valuable introductions in that line is constantly increasing. Thousands of acres have been planted to oranges, the only drawback of which, is that so often through frosts, disease, or other enemies to this golden fruit, the harvest of golden coin is prevented. The nut trees as a general thing are quite free from disease, not influenced by severe frosts, and not dependent on immediate sales, not being subject to rapid decay, as is the case with fleshy fruits. The timber of the walnut is known throughout the world for its value.

The Mammoth chestnut, so called for its large size, has been introduced, and is now grown in every State in the Union. It has come to us from Japan, from which country I would like to show you to-day a variety of walnut, which is sure to gain your favor. This nut is indigenous to the island of Yesso, the farthest northern boundary of the empire of Japan. The climate of Yesso is nearly identical with the climate of the eastern coast of the United States. Geographical and topographical issues might here be introduced to prove this assertion, but will omit, as your time is too valuable to branch out in anything of the sort. Sufficient to say that in consequence this nut tree would most likely flourish throughout the Union, north and south, and, no doubt, transplanted to our rich soil, improve in growth and fruit. The botanical name of this nut is "*Juglans cordiformis maximus*." The Japanese call it "Hemi-Kurumi." The name is derived from its distinctly heart-shaped, sharp-pointed fruit. From the seed the tree bears in the fourth year. The tree itself is like all walnut trees of fine appearance, and is said to attain a patriarchal age. Trees are found in Yesso, whose size proves them over hundreds of years old. As a dessert nut this nut equals the English walnut in flavor and is finer in appearance, as by boiling the nut for about five minutes, and then while still hot cracking it carefully on the edge, the kernel can be extracted as a whole, and the peculiar heart-shape causes it to look very unique. As long as our State is being denuded of timber on all sides by the ruthless axe of the lumberman, the fires of the careless sheep herders and campers, it behooves every farmer, horticulturist, and property owner to try and take measures to replace the precious growth which stands guard over the prosperity of our fertile valleys. Take from a country its trees, and you not only rob it of its chief beauty, but eventually will impede all vegetable life. This has been long recognized in older and crowded countries, where the forest laws are most stringent, and upheld by a vast outlay.

CAMPHOR TREE

This leads me to speak a word in favor of one of the most beautiful as well as useful trees, the "*Laurus camphora*," or camphor tree. It is easily grown from the seed, which has to be sown shortly after maturing, as the essential oil in the seed soon turns rancid and kills the power of germination. Sown fresh the young sprouts come up in from five to six weeks. Its growth is very nearly as rapid as that of the eucalyptus, whose properties it shares, also, in being claimed to keep away or counteract malarial influences through its pungent exhalations. In districts in Japan where this tree is planted largely, malaria is unknown. It attains a height of thirty to forty feet, and as has been proven in our own experience during the severe frosts in February, 1888, is hardier than the eucalyptus, which froze to the ground, while the camphor tree withstood it. The wood is valuable. Trunks or boxes of camphor wood are known as a preventive from the attacks of insects on fur or woolen clothing. The medicinal properties are too well known to need any mention. Who has not at one time or other taken refuge to spirits of camphor to assuage some pain?

We now import annually thousands of dollars worth of this commodity. Why not have the home-produced article? The method of extraction in Japan is as yet quite primitive. It consists in a species of distillation. The branches or wood is cut up into chips, and placed in a wooden tub which fits into an iron vessel under which a slow fire is kept up. The tub containing the chips is closely covered and the bottom pierced with holes. As the water in the iron vessel begins to boil, the steam ascends through the chips in the tub, separating the oil and camphor from them. The main tub being connected with a series of other tubs through a bamboo pipe, the cooled extract falls in the last of these tubs upon straw, which catches the crystals of camphor, while the oil and water escape into a lower compartment. The crystals are collected and packed for market, and the oil used for illuminating and various other purposes. Experiments have been conducted in this State, and proven satisfactory.

Why not give the camphor tree a chance, versus the time-worn "eucalyptus?"

EFFECT OF RAIN ON BLOSSOMS.

Essay by MR. GILBERT TOMPKINS, San Leandro.

I was once told by an experienced fruit man that if rain fell on the blossoms of young fruit trees, the fruit that formed from the water-soaked blossoms would almost invariably shrivel up and fall to the ground. I found this to be true on several occasions, and am watching the young cherry trees in our orchard with much interest, to see if the March rains will cause the downfall of the cherries in April and May. Some six-year old Black Tartarians were in blossom during the thickest of the storm, and if anything caught it they did. The Napoleon Bigarreau—Royal Ann—blossomed much later, and received but few showers.

The apricot blossom is generally quite hardy with us, and the trees usually form altogether too much fruit, which entails great expense in properly thinning. Nevertheless, rain at the time of the fertilization of the blossoms will cause a light setting of fruit; and the water-soaked blossom hangs around the newly formed fruit and causes the weakening of the stem until the fruit falls. This is particularly the case in warm weather.

There is also a critical time with peach blossoms, and when one tree blossoms in time for a storm that another dodges, the effect can be roughly estimated. In this present season it is reported from many places that the blossoms have been damaged, especially in Sonoma County.

In my experience, plum and prune trees have been the least affected, and showers that knocked out other blossoms have not hurt these; but I am doubtful if this is true of all localities. These trees drop large quantities of fruit, when too heavily loaded, under any circumstances.

I have no definite experience with apples or pears in regard to this source of damage, but I firmly believe that a well placed shower can seriously cut down the setting of these fruits.

In investigating this question, due allowance must be made and credit given for other causes that may have equal or greater effect on the dropping of fruit. A certain amount of fruit will drop anyway, rain or no rain.

These few observations are made for the purpose of drawing out the knowledge and opinions of those at this Convention. The widespread rain at blossoming time has stirred up unusual interest in this subject, and a few minutes given to placing on record what you have noticed at your homes will be well spent.

The above was written last spring (1889). The general results at this farm were very nearly in accordance with what was expected. Apricot and peach trees bore exceedingly unevenly—one tree having a fair crop while its next neighbor showed empty branches. This was caused by difference in the time of blossoming, through which one tree missed the rain that hurt the blossoms of the next.

In accordance with my previous experience, plum and prune trees showed less damage than most other kinds of fruit. The Bartlett pears seemed to have escaped blossom injury and bore fairly well. My apples were a failure; never were anything else, however, so it would hardly be fair to lay this to "Rain on Fruit Blossoms."

HORTICULTURAL MACHINERY.

Essay by Henry A. Brainard, San José.

Within the recollection of a middle aged man we have seen a wonderful progress in agricultural machinery, particularly in harvesting appliances, counting from the time when man grasped the growing grain by handfuls and cut it with the notched edge of the crooked sickle; when it was beaten from the chaff and straw with the flail, falling in measured cadences upon the thrashing floor, and winnowed in the evening breeze, down to this day when the ponderous machines upon our California fields do the work by wholesale at a rate which you know better than I can describe.

In horticulture it is only recently that machinery has come to play an important part, but the progress is quite rapid, and there are many operations connected with it, now profitably performed by machinery, which formerly required hand labor.

In the work of cultivation, horticulture has shared with agriculture the improvement in the machinery for breaking up and pulverizing the soil, but special implements have been invented to work close to the trees, and others to prepare the surface of the ground and put it in the best condition to endure drought, so that, in this respect, horticultural machinery is, perhaps, all that can be desired.

We can remember when trees were pruned with the axe and knife, but we now have powerful shears and sharp saws that seem nearly perfect in their operation; there may be room for improvement in tools for pruning large trees.

It is in gathering and preparing fruit for market that the more recent improvements have been made, and it is in this direction that invention may be exercised with great benefit.

Gathering fruit is still mostly done by hand. The only exception is the prune, which may be gathered by machinery with considerable advantage. A recent invention by a San José horticulturist consists of two pieces of canvas attached to each side of a San José orchard truck, on which are placed the fruit boxes, covering the whole bed. Driving the truck up to a tree two men quickly spread the canvas, a smart shake brings down all the fruit that is ripe enough, and quicker than we can tell it, the canvas is lifted and the fruit rolls into the boxes, passing in its way over some slats where all the leaves and twigs are separated. With this machine two men can do the work of twenty who shake and pick by hand.

Apricots and peaches must still be picked by hand, for no machinery can replace the eye, which distinguishes ripe from unripe fruit.

There is a machine, though, by which prunes can be assorted into any desired sizes, rejecting entirely all fruit that is not fit for drying. Grading is advantageous in drying the fruit evenly, and for packing for market.

What is now needed is an apparatus that will, in one continuous operation, pass these graded prunes through the bath of hot lye water, again through clear water, and deliver them on trays.

There is room for an invention by which these trays can be placed upon the drying ground or in the evaporator with less manual labor than is now required.

The perfect fruit evaporator has not yet been invented and there is plenty of opportunity for improvement. It is pretty evident that for driers on a large scale the heat must be distributed by means of steam pipes, or radiators, so that it can be regulated exactly without reference to the fire, only that it be hot enough to do the work.

Cherries, plums, apricots, and freestone peaches may be pitted by machinery for drying. For canning, the clean cut made by the knife in the hands of a skillful operator is still required, and we have seen a newly invented knife for this purpose, having a spur near the base of the blade for removing the stone, that seems the best ever offered for this purpose.

We have seen a machine that will pit one thousand two hundred cherries every minute, and if driven by power will require only one hand to tend it. By a little change the same machine can be arranged to pit three hundred and sixty apricots or peaches in a minute. Another machine saws the apricot or peach in twain with two revolving saws, which spring apart at the stone and remove it. Both these machines divide the fruit into equal halves, but in every possible direction in relation to the natural axis of the fruit.

We have seen another machine, yet in the experimental stage, which requires the fruit to be placed in position by hand, but the operation of cutting and removing the stone was entirely automatic. This machine will cut as regularly in relation to the axis as by hand if the fruit is symmetrical.

With fruit in the proper stage of ripeness these machines will doubtless answer the purpose intended. To one of these machines may be attached an arrangement for spreading the fruit upon the trays, but for this purpose the trays must be made to fit the machine and on purpose for it.

A better grading machine is needed for prunes after drying, for even if graded before drying they will not be exactly the same after this process. Apricots and peaches may, if desired, be graded before drying, but they always need more or less hand sorting afterwards.

Opinion seems to be against dipping fruit into hot water previous to boxing, but we are inclined to think that some heating process will be necessary to destroy insect germs, unless the fruit is evaporated and packed direct from the evaporator. Here, then, an invention is needed which will pass the fruit through a close, heated chamber before packing.

A machine is also needed which will automatically place the proper weight of fruit in boxes or sacks in the same manner as is done in the flour or starch packing machines.

In the care of orchards there is no more useful piece of machinery than the spray pump. There is hardly a month in the whole year when there is not need for such a machine. California inventors have been active, and the latest and best patterns of pumps have large air chambers and receptacles, holding several gallons, and the pressure can be raised and kept at a hundred pounds or more per inch, making a spray as fine as steam. The better class are equipped with a pressure gauge and relief valves, to prevent a bursting pressure on the hose or air chamber.

The great odds against which the American fruit grower has to contend as against the European grower, who has cheap labor, cheap ocean freight and small import duty, must be made up by utilizing our productive soil and climate and the perfection of machinery to do much of the work which has been done by hand.

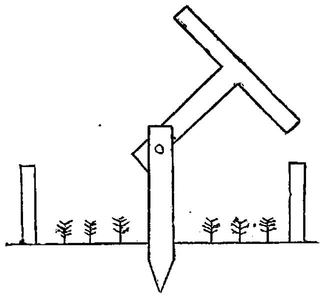
ORANGE CULTURE.

Essay by **Fred. C. Miles**, Penryn, Placer County.

In the following lines I have purposely omitted many things in connection with the propagation of trees, because they would be only a repetition of facts that have been ably presented to your Conventions.

In planting I use the seed from large Tahiti oranges, as so far the stocks raised from them have given the best satisfaction. The practice has been, as various works advise, to cover the seed from one to two inches with soil or sand, or both. I have had the best success here by planting the seed in June (about the tenth), barely covering the seeds with soil, and then applying a dressing of one half inch of chaparral leaves. The latter prevents the soil from baking, and keeps the seeds moist, the beds not drying out so quickly as with sand. The seeds are sown broadcast in beds, and are only allowed to dry before planting, so that they will not stick to the hand when sowing, and only the seed is used that will promptly sink to the bottom in a water bath. Treated as above the plants have been up at eighteen days from sowing the seed.

For covers, for protection from the sun, the thin lining cloth, 5 cents per yard, is used. I do not use the stationary cover so largely in favor in Southern California, but use a frame made as shown in the sketch.



The pointed stake, size preferable one by six by twenty-two inches, having a hole bored near its top, is driven in the center of bed before the seed is sown. A T is made, having the top somewhat longer than width of seed bed. The leg of the T is, for our hot climate, twenty inches long, and has a hole bored near the bottom. A bolt is passed through the two pieces and the cloth held to top of T by a lath tacked on. The friction of the two pieces of boards is sufficient to keep the covers in place at any angle one may desire. The great advantage of these covers is that they can be turned so that the plants can have the benefit of the sun at any time, and on this account made stronger and sturdier trees. Another thing that helps their growth is the daily sprinkling that the plants receive in summer. I have seen plants that were drooping in the sun revive when a very fine spray was showered over them. In our section the transplanting to nursery rows should be in March or April, as in those months the conditions are extremely favorable for moving orange trees. And this remark can be applied to setting in orchard form as well.

The nursery rows, if on hilly ground, should have a grade of not less than six inches to the rod. The plants, from the time they appear above the ground, have to be supplied with moisture, and when in nursery rows or orchard must have plenty of water. I have experimented with using water, and have found that it is best to intelligently use an abundance of it. The growth, both top and root, where I have done as above, has left nothing to be desired.

Budding is begun when the trees are from fifteen months old or upward. Probably the best per cent of good buds is obtained by working them on two-year stocks. It is an open question whether spring or fall budding is the best. I am inclined to fall budding, but experiments now in progress will soon give more definite information.

LEMON CULTURE.

Essay by **Dr. O. H. Conger**, Pasadena.

Twelve years ago there were but little, if any, reliable data available upon this coast relative to lemon culture. The orange was the only citrus variety of fruit that attracted general attention or was discussed with the newcomer. Finding, however, that climatic and soil conditions favored the lemon culture equally well with that of the orange, and being entirely ignorant of the requirements of both, the writer regarded the joint experiment with as little distrust as that of the single venture; but upon diligent inquiry there were no lemon trees to be obtained; yet, as good luck would have it, a few young, bearing trees were found that had been grown from cuttings or slips, and, taking advantage of this ocular demonstration of the possibility of the future in this culture, several thousand cuttings were secured and put out in the most thorough manner that the skill of a novice could suggest.

The method adopted and the results obtained in this initial trial will, no doubt, be as interesting to those present, if not the general public, as any effort of the writer for the present occasion.

The cuttings already referred to were made from the last growth and matured wood of young, bearing trees, and in size from one quarter to one half inch in diameter and from twelve to fifteen inches in length. The time of cutting them from the tree was during the most dormant stage of sap flow; which is readily determined by the tenacity with which the bark adheres to the wood, or, in other words, when the bark will not peel or slip, hence budding is always deferred until the bark slips. Cuttings, therefore, should never be cut from the tree when the sap is flowing, but when obtained, they should be healed in moist sand until May or June—the two best months, probably, for putting out, owing largely, doubtless, to the greater warmth of the soil at this season than earlier, a condition highly favorable for early promotion of rapid growth. All citrus trees require warm, moist soils while young as well as in more mature years.

SETTING

The most favorable soil in which to start the cutting is unquestionably a sandy loam, possessing as it does the power to retain moisture as well as to supply plant food readily. Less fertile soil, however, may be made to answer every purpose by enriching the surface, and a more frequent use of water. Dig a trench one foot deep and the same width, and with a tamping tool made of a two by four scantling, pound the bottom of the trench until it is solid and firm, upon which place the cuttings solidly fifteen inches apart, and haul back the earth thrown out, four inches deep about the cuttings as they are placed in position, and when the setting is completed tamp this four inches of earth about them as thoroughly as though each one was a post. This is to insure their starting, as cuttings of all varieties of plants or shrubs fail to grow unless the earth is firmly packed at its base or at some point above not far from it. Again haul in four inches more of earth and then fill to the surface with water, and four or five days thereafter complete the filling of the trench with earth, and then mulching with fine material the surface, and but one other irrigation will be required for the season unless cultivation is neglected and weeds are permitted to sap the moisture in the soil.

By adopting the foregoing method a growth of two to four feet will be obtained the first year, and the second year in June many of the strongest growers can, with advantage, be placed in the orchard.

TRANSPLANTING.

A practice has been followed by many to cut away the radical or tap-root of both the lemon and orange tree when taking them out of the nursery for transportation. While this may facilitate to a certain extent the handling, it is greatly at the expense of the already stored energy of the plant, as well as unnecessarily greatly abridging its capacity to recover from the shock sustained. The experienced eye readily detects the area occupied by the roots of the young tree by the size and shape of its top, and is therefore guided in his efforts to preserve the roots from harm while digging to remove it. Not only should the roots be saved harmless when removing the young tree from the nursery row, but also from the sunlight and drying atmosphere by wet cloths being immediately put over them as they are taken out. The holes having already been prepared for the trees, further shaping may be required to accommodate the size and form of root surface, especially the radical or tap-root, by pointing a piece of inch gas pipe, if nothing else is already provided for the purpose, and drive a hole from the dug portion deep enough to receive the full length of this tap-root. By thus restoring, as far as possible, the full capacity of the root surface, the vital energy is little (or less) taxed in renewing its full functions under the laws governing plant life. Another important consideration in this connection is to carry nothing but fine clean soil down about the roots with a small stream of water, instead of shoveling in indiscriminately everything present and treading with heavy boots the soil about the roots. After completing the work thus far, three or four weeks can elapse before again irrigating, which should be very generous, and will also suffice for the balance of the season, supplemented from time to time with thorough cultivation. Indeed, no subsequent irrigation will be necessary until the tree has reached the age of fruiting.

SOILS.

Different opinions prevail respecting the most suitable soil for the lemon, and the expression of *best* soil is too often localized, and many times, possibly, for unworthy purposes. However, from the fact of the more delicate and sensitive nature of the lemon than that of the orange tree, suggests at least somewhat different conditions for the lemon than experience teaches us is acceptable for the orange.

The sandy, gravelly soils, with a fair amount of humus as a constituent, is probably nearest a typical soil. Such soils are controllable, yielding or withholding plant food at the bidding of a skillful manipulator.

An orchard of lemon trees so favorably disposed needs only directing. The day of putting forth its bloom, the ripening of its fruit, as well as anticipating the needs of the markets, and consequently highly remunerative prices, are all forshadowed under so favorable a set of circumstances.

Sandy soils supply sufficient moisture, by frequent cultivation, to sustain the life of the lemon tree perpetually, independent of artificial irrigation, while in a clayey or stiff soil, in the same period of time, they would succumb. Double the expense also will be required to reach results in the stiff soils that are requisite in the sandy soils, besides the objectionable feature also of inferior quality and other economical values.

Fertilizing poor soils to meet an apparent demand is a matter of judgment and discretion, but too rich a soil for the lemon, especially of the clayey class, leaves little discretionary power in the hands of the manipulator. The overgrown, coarse, thick rind product is ever present. Water becomes the arbiter to decide the blossom period of the lemon in sandy soils.

Irrigation postponed until the months of July or August secures marketable lemons ten months hence, and limiting the curing process to two and three months thereafter brings them into market when most desired and also at top prices. The economical requirements of water in sandy soils has a great advantage in many ways also over the clayey soils, which is of marked interest in many sections.

CUTTINGS VS. SEEDLINGS.

The experience of fourteen years in the lemon industry has also demonstrated to the writer the practicability of growing as thrifty fruit-producing trees from cuttings as from seedlings, or by budding, and at a considerable saving of time and money. May and June are good months to propagate the cuttings, as the soil is then warm, which is an indispensable condition to prevent the sap souring or the cutting molding at its base where the cicatrix is forming preparatory to the manifestation of the function of cell growth, or the commencement of life of the future plant.

As to the variety of lemon to propagate, with all due deference to other varieties, the Eureka stands as the present favorite. The bearing age from cuttings commences at the third and fourth years. The Eureka is also nearly a thornless tree, and the lemon carrying fewer seeds than most other varieties.

In regard to shaping the form of the tree by judicious and timely pruning, there can be no very arbitrary rule laid down, for in sections frequented by strong winds the shaping of the tree should be almost entirely different than in localities more fortunate in this respect. Exposed or liable to wind storms, the limbs should be permitted to form within two feet of the ground, and continually cut back so as to encourage short, unyielding arms to bear the fruit, whereas in protected localities, shoulder the limbs four or five feet up the bole and encourage low spreading tops, for the double purpose of shading the ground and facilitating the picking of the fruit, and in case of the necessity of spraying, a great additional advantage will also be secured in reaching all portions of the top at much saving of expense and trouble. Frequent pruning of the lemon tree is less a necessity than that of the orange, and should be confined more to the shaping than thinning out, unless infested with the scale pest. The size of the lemon is due principally to two causes. The overgrown size results from over feeding the product on the tree in making soluble the food by excessive use of water, whether there be a more or less prolific crop. The undersize, on the contrary, is either due to starvation by neglect, or a diseased tree, or both; for it is well known that the reproductive powers of the tree are largely increased when attacked by disease, which can be demonstrated by girdling the trunk or large limb of a tree at an immature age. Oranges can thus be produced from a seedling tree at from five to seven years of age.

THE MARKET LEMON.

The processes are various for preparing the lemon for market, but the first injunction is to handle them most carefully at the time of picking, for the very important reason that if the rind of a lemon is abraded at first handling, while gorged with its acrid secretions, the oxygen of the atmosphere tends immediately to excite a depraved condition at the point of injury, the same as would occur in man or the lower animals, and to this carelessness is almost invariably due the decay of fruit.

To obtain the lemon from the tree entirely free from injury, is the first great requisite for future success in curing, and when so received at the place of carrying on the future treatment, all subsequent handling need involve but slight risks from the packing house to the markets. The first, and probably the safest method adopted by the writer, was to spread coarse litter from the barn-yard straw piles or leaves about in the shade of each tree, and pick and make shallow piles upon this straw floor, and permit them to remain undisturbed from one to two weeks, owing to the dry, hot, or moist and cool condition of the atmosphere, before removing them to the packing house; and by this means alone the loss was reduced to the minimum, and also what few were injured were at once rejected, saving the balance from inoculation by the decay already set in.

WHEN TO PICK

The best qualities of the lemon will be preserved by picking as they commence to color. At this stage of development they have received all that the tree can impart, and not before. Others, however, advocate picking when they attain a certain size, measuring by arbitrary standards, regardless of degree of development. But, as before stated, size should be controlled by soil and treatment. The fine delicate flavor of the juice of a lemon that matures on the tree, and is properly cured by process thereafter, is readily distinguished from the marketable immature sample, besides yielding a larger amount of juice and citric acid. As to the demand of commerce, in regard to size for fancy prices, a lemon weighing from three to five ounces, two to three months after picking, and measuring from two and one half to three inches from blossom to stem end, with a nearly uniform diameter crosswise from two to two and one half inches, will fully meet all of the desired requirements.

CURING.

The varying processes followed by those engaged in this industry differ more in detail than principle. To the experienced, or the person of keen judgment, but little can be suggested, as each locality has conditions of temperature, moisture, etc., peculiar to itself in many respects, which possibly militate for or against a practice acceptable in another section. A good method, to say the least, is to first leave them under the tree, as above stated, to wilt and toughen, so as not to readily receive injury by rough handling, which they are liable to with the available and usual help employed. Removed to the place of storing during the curing period, they can be placed upon trays so made that in single layers they can be piled one above the other without risk of injury by pressure. Thus disposed and placed in rooms as much protected from light as possible, cool and well ventilated, they can be carried in this condition with but a trifling loss for months if desired, that the best market may thereby be secured. And no more desirable lemons can be put upon the market from any portion of the known world than can thus be produced upon thousands of acres throughout Southern California. And when we fully begin to realize the unnecessary drain upon our country of from five to ten millions annually for lemons alone, and our virgin soil capable of yielding this enormous revenue still unoccupied, it should arouse the people of this unrivaled section of the State to immediate, thorough, and persistent endeavor to grasp this vast income in the near future. It is not only within the reach of thousands to participate in this protective wealth, under the rich endowment nature has bestowed in soil and climate, but also a rich legacy for posterity in perpetuity.

Mr. Holt: If you let the idea go out that the rule that seedling lemons and lemon trees from cuttings are a success in California, a great many people are going to get left. I have not the least idea but what our friend has the best lemon orchard on the Pacific Coast; we will concede that for the sake of the argument, and yet we know as a fact that as a rule the seedling lemon is a failure in California, and that the old seedling lemon orchards of this State have divers diseases, and that as a rule the seedling lemon is not a healthy tree. I mean to take the State at large. We know another thing, and that is that the average seedling lemon in this State is not a good lemon. There are exceptions to that rule; there are men here present who will very well remember the original tree from which the Eureka lemon was propagated; that was a seedling tree, and a large number of lemon seeds were planted, and trees grown, and only one tree that reached up above all the other trees and made a magnificent fruit.

Mr. Cooper: I wish to state that in all French literature on the question of growing from cuttings it is stated that it has been discarded for many years. That is the most curious fact, that in all the French literature, which is very elaborate and very extensive on the subject of growing citrus fruit, that the method of growing trees from cuttings has been discarded for many years.

SCALE OF POINTS FOR JUDGMENT OF CITRUS FRUITS.

Essay by J. E. Cutter, Riverside

To the honorable the State Board of Horticulture:

Gentlemen: In response to your courteous request for a "paper," subject at will, I find *nolens volens* the above topic thrust upon me. A letter just received from Hon. P. J. Beckmans, President of the American Pomological Society, tenders to the writer an appointment as member of a committee whose duties are defined in the above caption, and whose report is to be made at the next meeting of that Society in 1891. The other members are Mr. Austin W. Roundtree, of New Orleans, Chairman, and Mr. A. H. Manville, of Denver, Putnam County, Florida.

The consideration of your meeting is therefore most fitly invited to the subject. I regret exceedingly my inability to be present with you.

The Florida pomologists have considered this matter before us, and already have in use a "scale," which, in its various modifications, has occasioned in that State no little discussion. It will be pressed upon our committee for adoption, and should therefore be "investigated" very thoroughly by us of California. The more complete your analysis of it the better we shall be prepared to act, and the more safely we can compete at future trials. I here give their scale as used at the last meeting of the American Society at Ocala, Florida:

Physical Characteristics.		*Juice Characteristics.*	
Size	10	Juiciness	10
Appearance	10	Sweetness	10
Thickness of peel	10	Sub acidity	10
Absence of pulp	10	Vinous flavor	10
Absence of seed	10	Absence of free acid	10
	50		50

Total number points in perfect orange ---- 100

It would seem that "vinous flavor" might better be termed bouquet.

Mr. H. E. Van Deman, Pomologist Department of Agriculture, U. S. A., challenges this "horizontal scale," and suggests the following substitute. See "Florida Dispatch," of April 4, 1889, in which he has a paper of considerable length, and in which also Hon. C. F. A. Bielby, of that State, replies to Professor Van Deman:

New or Suggested Scale.

(1) Thickness of peel, 1 to 10. (He evidently meant size.)	Standard 2½ to 3 inches, with one point off for every ⅛-inch less than 2½ inches. Nothing credited for over size.
(2) General appearance, 1 to 20.	Freedom from all blemishes—as rust, scale, decay, bruises, and lack of properly cut stem.
(3) Weight, 1 to 15.	Should sink in water. Points deducted according to buoyancy.
(4) Thickness of peel, 1 to 10.	Standard, ⅛-inch thick, or less. Two points off for each additional 1/16.
(5) Absence of "rag," 1 to 10.	Standard ⅛-inch diameter of core; segments thin and tender.
(6) Absence of seed, 1 to 10.	Standard, seedless.
(7) Flavor, 1 to 25.	Judged by satisfactory taste.

Professor Van Deman contends against making one sixteenth inch the standard of "thickness of peel," according to the Florida practice. Right here I remark that no orange is perfect without faultless shipping properties. Without that all else is useless in this industry. The superb shipping qualities of the California fruit are due to a thicker peel than one sixteenth inch. My own view of this most important matter is that the standard of this point should be three thirty-seconds to three sixteenths. Who finds fault with an orange of this (suggested) maximum?

The writer invites communications from our horticulturists on this subject.

* * * * * * * * * * * *

PALMS FOR ORNAMENTAL AND INDUSTRIAL PURPOSES.

Essay by Professor Henry Chapman Ford, Santa Barbara.

In the tropical and sub-tropical regions of the earth no representatives of plant life, wild or cultivated, are more grandly graceful and beautiful than the palms. With structure intermediate between herbaceous plants and trees, they vie with the latter in loftiness of height, grateful shade, elegance of form, and symmetry of proportions. With never-ceasing development, they lift their elegant crowns often above the jungles and forests in distinctive grandeur, perennially producing flower and fruit. Linnæus denominated them the Princes of the vegetable kingdom. Add to their beauty of form the wide range of their economic uses, and we can readily

give them a preëminent position in the whole world of plants. The fruit, foliage, and wood, the fibrous tissue, and starchy pith, and fermentable or medicinal sap, are utilized in a thousand ways, which have proved sufficient to supply all the wants of a primitive people.

Various species yield highly valuable products for domestic consumption and foreign export. The fresh and dried fruit of the date palm (*Phœnix dactylifera*); the nut of the cocoanut palm (*Cocos nucifera*), yielding food and oil, while the trunk furnishes a timber commercially known as porcupine wood, used in Europe for furniture, etc.; the leaves are plaited into fans and baskets; the shell of the nut is utilized for drinking cups, and its trunk serves as fiber for cordage and brushes. Sugar is also obtained from this palm, as well as from a half dozen other varieties.

An abundance of starch is obtained from the sago palm (*Sagus rumphii*) and some other members of the family. The fruits of the oil palm (*Elæis guineensis*) yield the commercial "palm oil."

A resin called "dragon's blood" is procured from *Calumus draco*. Vegetable wax is obtained in abundance for export from the South American palms, *Ceroxylon andicola* and *Copernica cerifera*, and the nut of the ivory palm (*Phytelepas macrocarpa*) is used extensively as a substitute for ivory.

Of the family over fifteen hundred species, distributed in one hundred and thirty-two genera, are scientifically described. The larger number are confined to the tropics, yet many are indigenous in the warmer portion of the temperate zones; 44 degrees north latitude and 38 degrees south, seem to be the limits of their successful growth. Some species, however, are found in New Zealand at 44 degrees south.

Great heat and moisture are requisite to their highest development, yet members of the family are found where neither are in excess. Four species are indigenous on the Atlantic Coast of the United States, some as far north as 33 degrees, and a single native species attains a like latitude on the Pacific Coast. The United States genera all belong to the group *Coryphinæ* or *Sabalinæ*, distinguished by their fan-shaped leaves and perfect flowers.

But little can be said in the limits of this article of the botanical characteristics of the family. They are perennial, woody, monocotyledonous plants, the stems of most species attaining a considerable height, while some of the dwarf palms are nearly stemless. The trunk as it rises is generally uniform in thickness, unbranched and terminating in a crown of pinnate or palmate leaves.

Some genera (*Calamus* and *Desmoncus*) are weak stemmed, using other trees for support, and are climbing in their habit. The stems of these often attain a length of five hundred and six hundred feet, being, perhaps, the longest plant growths in the world. The flowers are borne on simple or branching spikes, protected by a spathe. The flowers of most species are monœcius, or male and female borne on the same stem, while others are diœcious, or having the staminate and pistilate blooms on separate individuals. The fruit is a drupe or berry inclosing a horny albuminous seed, with a small embryo. The petioles of the leaf in many species are set with horny spines, linear, or hooked, and the stems of others bristle with formidable thorns of needle sharpness.

The fruit of the palm is very slow in coming to perfection. Eight months in many species, three years for that of *Sagus rumphii*, and ten years bring the stony nut of *Lodoicea shellarum* to maturity. The latter, known as the double cocoanut or maldivian nut, is three feet long, the same in circumference, and weighs over fifty pounds.

The structure of the palm trunk renders it strong and flexible, with ability to resist violent storms, where the more brittle exogenous trees would succumb. This fact should have weight in the selection of distinctive plant growths for the more exposed situations of our region. Some palms produce from the base of the trunk adventitious roots, similar to those of a stalk of corn, which grow downward and enter the soil, serving further to strengthen the tree.

In pointing out the species that, from their habitat and hardiness, would seem to find within the limits of California congenial conditions, I shall first refer to those indigenous to our State or its near valleys, then to such as have already been satisfactorily tested, and the untried species that should obtain an introduction and trial.

Washington palm, *Washingtonia filifera*, formerly known as *Brahea filamentosa* and *Pritchardia filamentosa*.

This noble California fan palm is indigenous in several sheltered cañons of San Bernardino and San Diego Counties, at the eastern foot of the rocky slopes of the Sierras. At the head of Palm Valley is a grove, numbering five or six hundred trees, several individuals of which are over three feet in diameter, and from fifty to eighty feet in height. This species has a magnificent crown of flabelliform leaves, the petioles of which are armed with horny hooked marginal spines, and to the divisions of the leaf are attached plentiful long thread-like filaments, which give its specific name. The fruit is an ovate, black drupe, with a thin sweet pulp, containing an oblong ovate horny seed. The Cahuilla Indians who occupy the reservation in Palm Valley have long made use of this fruit for food, and, according to Dr. Stephen Bowers, they also soak the fruit in water until fermentation takes place, making an intoxicating drink. From this and other groves east of the San Jacinto Mountains California nurserymen have obtained the seeds from which have been produced the fine specimens of this palm that are scattered here and there over the State. From this source the Franciscan fathers also procured the noble specimens of this palm that now stand in the old mission garden of San Fernando, planted by their hands nearly ninety years ago. The most lofty of the three that stand as sentinels over the fast crumbling mission is about fifty feet in height, with a circumference one foot above the ground of eight feet and five inches. Its trunk rises with little diminution of diameter to the crown, while the leaves in their annual decay seem to have been deciduous, leaving a bare brown stem, the lower portion of which has longitudinal sutures not unlike some exogenous trees.

Another of the group has a circumference of nine feet and five inches, but its altitude is less than the one just described, being about forty feet. On the trunks of this and its lesser companion the dead leaves have from year to year remained persistent, clinging to the stem until a close thatch has been formed, the warm grays of which form a pleasing contrast with the brown trunk below and the green crown above. Each of these palms seem to have borne flowers, the barren stalks of which appear quite beyond the leaves in length. It is doubted that any specimen in California outside of the native groves have yet perfected fruit with germinating power. The San Fernando palms have probably not been irrigated since the early part of the century. Had more abundant irrigation been applied, their dimensions would no doubt have been increased; but in their present estate they are a strikingly noble feature in the landscape from all points of view; especially so with the quaint old mission, with its tiled roof, long corridor of Moorish arches, and the Sierra Madre for a background, showing in an emphatic manner the possibilities of scenic effects when this grand palm finds a position in all our valleys.

In its native habitat it grows often among the rocks, but it thrives in almost every soil and situation where the altitude is not too great. The growth can be forced by plentiful irrigation, but when well established little water is required.

One of our most beautiful birds, Bullock's oriole, makes use of the long thread-like filaments that are attached to each division of the leaves in the construction of its nest, dextrously drawing the strong strands through the leaf and suspending the structure from the under side. As many as a dozen have been noticed on a single palm. By bleaching the newly formed leaves and stripping them to a proper width, an excellent material is obtained for the construction of many useful articles, such as ladies and gentlemen's hats, baskets, etc. Mrs. Joseph Saxton, of Goleta, recently exhibited various beautiful specimens of her handiwork, in which this material was used, pointing forcibly to a promising industry, should these palms be extensively grown. I have dwelt upon this species for its hardiness, availability, cheapness, exceedingly rapid growth, beauty, and possible utility. Certainly no member of the family can add greater charms to the landscape when gathered in groups or used along our avenues. The persistent leaf stalks that mar the appearance of the trunk may be removed without apparent injury to the vitality of the tree.

The Guadaloupe Island palm, *Erythea edulis*, formerly *Brahea edulis*, is a beautiful fan-palm, native of the sheltered valleys of Guadaloupe Island, and has been somewhat sparingly introduced. It has a slender trunk, sometimes thirty feet high and fifteen inches in diameter, with its naked bark, thick, corky, and deeply cleft. The flowers are borne in clusters, one to four on each tree, in a much divided panicle four feet in length, blossoming late in March. The fruit is somewhat over an inch in diameter, and has a thick, sweet, and edible pulp. The clusters of fruit sometimes weigh fifty pounds. The leaves are fan-shaped, blade three feet in length, with foot stalks without spines. While young this species is less rapid in its growth than the Washington palm, but when fully established and irrigated properly its increase is satisfactory. The fruit has matured at Santa Barbara, from which plants have been propagated by the nurserymen.

Another species of this genus, *Erythea armata*, is found in the Big Cañon of the Tantillas Mountains, Lower California. The mature specimens are taller and more graceful than the last, rising to the height of forty feet. The leaves are quite smooth, the stalks being bordered with horny hooks. The fruit is smaller than the last described. The unexpanded leaves could no doubt be used in plaiting for hats.

The date, *Phœnix dactylifera*, is without doubt, next to the cocoanut palm, the most useful member of the palm family. Its native country is not known. Throughout northern Africa and southeastern Asia it has been a much valued production since the earliest written records. It is the principal source of wealth in Arabia, its fruit forming a staple food supply, and in upper Egypt many families subsist almost entirely on dates. Although not so striking and full of majesty as some of the family, yet it is a beautiful species. At its best estate it sends up a noble column to a height of sixty to eighty feet, with a nearly uniform diameter of fifteen to twenty inches. The trunk is strongly marked by scars of shed leaves. At the summit is formed a magnificent crown of graceful pinnate leaves, each being from ten to thirteen feet in length. The leaf stalks at the base are surrounded by a membraneous sheath. The leaflets are disposed along the mid-stem alternately, the lower ones being terminated in a sharp spine.

When the leaves are forming they are twisted and doubled with a matted mass of loose fibers, which give way as the leaf expands. The flowers spring from the axils of the leaves in large bunches or spikes, first being inclosed in a spathe, which opens to let them expand, then shrivels and withers. It is a unisexual species, having male flowers on one tree and female or fruiting ones on another. The staminate blossoms are much larger than the pistillate, the latter having in place of stamens the rudimentary dates about the size of small peas. Several bunches of flowers are formed in a season, each often producing as many as two hundred dates.

The diœcious character of this species makes it necessary to resort to artificial fertilization, unless the trees are in close proximity. Although of the same species, wild dates are said to impregnate themselves, while cultivated ones will not bear without assistance. Fructification is accomplished by suspending the staminate flowers over the fruiting blooms, when the pollen readily performs its natural office. Another method used by the Arabs is to cut the unopened spathes of the male tree, divide them into small sections, climb the female tree and insert one of these bits into each spathe. The ancients understood the importance of artificial fecundation, Theophrastus and Pliny speaking of the practice.

Fertilization is sometimes brought about by the winds wafting the pollen to the female trees from a considerable distance. A female date tree near Otranto, Italy, had never borne fruit until a favorable wind wafted the pollen of a male that was forty-five miles distant. Another ancient maiden palm upon the island of Cyprus is said to have been barren many centuries, until one year the inhabitants were surprised to see it laden with fruit, having doubtless received the needed quickening upon the breeze borne from some unknown source. Hasselquist, in his observations in Egypt, speaks of the Arabs taking the precaution to preserve some of the unopened spathes of the male flowers from one year to another, the inclosed pollen being used in case the fertilizing property had suffered any damage. The fruit of the date is generally an oblong drupe, yet there is great variation in form, size, and color. The dates are borne in much divided clusters, each bunch having the fruit distributed alternately along it. A mature date tree will produce annually eight or ten bunches of dates, each weighing from eighteen to twenty-five pounds. There are as many recognized varieties of the fruit as of apples in the temperate regions. The seed is elongate-oblong in shape, with a deep indentation along the back. The kernels are exceedingly hard and horny, yet the Egyptians break them and grind them in their hand mills, using the meal as food for their camels. It is also used in making a drink, like coffee, which is said to be excellent.

Four or five months after the fertilization is performed the young dates begin to swell, and after attaining their full size they are tied to the leaf stems to prevent them from being bruised or beaten by winds. It requires about a year for the fruit to ripen. If designed for preserving they are gathered a little before ripening; but if intended to be eaten fresh they are allowed to ripen to perfection, and in that state are agreeable and refreshing. Ripe dates cannot be kept long, nor will they bear transportation any great distance without fermentation and souring, therefore, those that are designed for export to a distant market, or for storing and use at home, are dried upon mats in the sun. A date paste is prepared by pressing the fully ripened fruit into large baskets, and this product is the principal source of food in some parts at the season when no ripe dates can be procured. In the oases of the desert and many other North African localities dates are pounded and made into cakes for future use as food for man and beast.

The exported dates contain about half their weight of sugar, 6 per cent of albumen, and 12 per cent of gummy matter. Date sugar is a valuable commercial production of the East Indies, obtained from the sap of *Elate sylvestris*, a palm so closely allied to the date that it is conjectured to be the parent of all cultivated varieties. The juice is boiled down for sugar, but is also drank fresh, or after fermentation and distillation, as arrack, an intoxicating liquor. Dates added to water afford by distillation a mild drink, and palm wine is made from the juice of the tree, the use of both being considered in Mahomedan regions as breaking no commands of the Koran. The sap is obtained only at the expense of the life of the tree. At a period of its most active yearly growth the crown of the tree is cut off and a cavity scooped in the top of the trunk, which is filled with the rising sap at the rate of a gallon per day for two weeks, diminishing from that time to the end of two months, the trunk at that time becoming quite dry, and fit only for firewood. The unexpanded leaves in this, as well as other species, are used as cabbage, but this also destroys the tree. The central portion of the date cabbage has the taste of a fresh chestnut. The fiber of the date is used for ropes, baskets, mats, and many other domestic articles, as are also the stalks that bear the fruit. Even the leaves of this palm enter into the construction of coarse ropes, baskets, panniers, and mats, the length and narrowness of the leaflets, and their toughness, being well fitted for the purpose. In Spain, and some parts of Italy, palm branches have a commercial value, being used in religious processions, and for decoration, by both Christians and Jews. In the province of Valencia and in the vicinity of Genoa there are fine forests of palms, from which other portions of Europe are supplied with palm branches. The town of Elche, in Spain, is surrounded by a planted forest of about eighty thousand date palms, and the sale of the leaves, outside of the value of the fruit, brings a considerable income to the place.

The cultivation of the date is a matter of the highest importance in the countries of the East. The seed germinates readily, but there is no more certainty of its coming true to the parent than in the seed of apples. For that reason it is best multiplied by the suckers or offshoots that are plentiful at the base of the trunk. The tree thrives best in a moderately warm and dry atmosphere, with its roots in moist soil. It is a slow growing tree even where the soil and climate are most favorable, the old trees adding to their height scarcely more than a foot in five years. If the growth was uniform, it would take three hundred years to attain the height of sixty feet. Irrigation is necessary in the East, and it would also be requisite in California. A slightly saline soil is best adapted to its growth, and when not present naturally, according to Pliny, it was customary to scatter salt a little distance from the roots of the tree. If planted from the sucker, the first fruit is borne in four years, becomes plentiful in seven or eight, and continues prolific for sixty or seventy.

Five bunches of fruit were produced on a date palm grown near Phœnix, Arizona, that was only seven years from the seed, and trees have borne in Florida when five years old. On the estate of the late Col. W. W. Hollister, near Santa Barbara, several trees have perfected their fruit annually for the past five years, and fine bunches of dates from this plantation have been exhibited at the late Exposition at New Orleans, at the State Fair at Sacramento, and at the local exhibitions of the Santa Barbara Horticultural Society. These palms are now about seventeen years old. They have been carefully cultivated and irrigated several times during the drier portions of the year. The suckers that sprang from the base of this palm in its earlier years were annually removed. Date palms have fruited in several other localities in our State. That the raising of dates for market will ever be a profitable industry in California is a problem for future horticulturists to solve, but the results already obtained certainly warrant further experimentation.

There are a multitude of valleys in Southern California and Arizona that furnish the proper conditions for its successful growth. The Franciscan friars introduced it with other Mexican productions at the establishment of the mission gardens, fine specimens being still to be seen at San Diego, San Luis Rey, San Gabriel, San Fernando, and at San Buenaventura. Some of these palms annually produce flowers, yet there is no evidence that the fruit has ever been perfected. This is probably owing to the fact that artificial fertilization has never been attempted.

In answer to a letter written by O. F. Thornton, of Arizona, in 1887, seeking information in regard to the date, the following was received from the acting Commissioner of Agriculture:

UNITED STATES DEPARTMENT OF AGRICULTURE, COMMISSIONER'S OFFICE,
WASHINGTON, D. C., July 22, 1887.

O. F. THORNTON, *Esq.:*

DEAR SIR: I have to acknowledge your communication of June twenty-second, with its printed inclosure relative to date palms.

Referring the matter to our horticulturist, he reports that some twelve years ago the department, at considerable trouble and expense, procured about two dozen large rooted suckers from first quality bearing dates, but they reached here in bad condition.

It may be true that the date furnishes food for millions of people in the Orient, but it is a matter of plainest fact that the people of the United States are not particularly dependent upon it as a food.

Our civilization demands a superior class of foods, and the date can never, in this country, become of any importance as a food plant, so that it does not seem of sufficient moment to warrant the Government's expenditure of money to make efforts to introduce the date as a valuable food plant.

In raising plants of the date from seeds of best varieties, the chances for good bearing kinds are about the same as raising grapes from seeds.

The department can furnish date plants from seeds of good bearing varieties which would answer the purpose of testing the climate. These were obtained from the hardiest varieties.

Very respectfully yours,

F. C. NESBIT,
Acting Commissioner.

The "Phœnix Herald," commenting on the above, says:

> The Acting Commissioner really overlooks the present important question to the people of this country concerning the date, which is rather whether the date is a profitable fruit to produce.
>
> The orange, the lemon, the lime, the pineapple, the olive—can none of them be of any importance as food plants, according to the honorable Acting Commissioner's way of looking at it, and yet they are of sufficient importance to be worth millions of dollars to the country annually as crops, and from the cultivation of which fortunes are being constantly made; and yet they are of no more importance than the date, which is imported in immense quantities, and performs a most important part in producing the very necessary element of variety in food when the best health is to be considered.
>
> Again, the hundreds of thousands of dollars that go out of the country for dates alone each year would be retained at home, the fruit would be cheaper to the consumer, and its consumption would rapidly increase. There is scarcely a doubt that could it be had as cheaply as the raisin, it would be as largely used, and of as much importance to the country.

The belt of country lying along the eastern base of the San Bernardino, and thence south to the Mexican line, would seem peculiarly adapted to the raising of this species, being the region where the Washington palm luxuriates in the seepage of alkaline water, which is grateful to the date. Artesian water is now readily obtained in numerous places in the so called desert, and around which the date might be planted, transforming the locality into a veritable oasis, similar to those noted in the Sahara. Even should further experiment not warrant the cultivation for its fruit product, there are many reasons why this hardy palm should find a position in our plantations. The long pinnate fronds, even in young specimens, wave gracefully at the slightest breeze; their beauty of form and gray green color contrasting charmingly with other vegetation wherever placed. Some of the various products that have been enumerated might find utility here. The other members of this genus that have already proved hardy in California, or would probably succeed upon introduction, are the following: *Phœnix reclinata*, from southeastern Africa, a hardy species, not tall, often reclining, and adapted for ornamentation. The seeds are used as a substitute for coffee. *P. acaulis*, a dwarf palm from the slopes of the Himalayas, where it is found at a height of seven thousand five hundred feet. It is exceedingly ornamental.

P. ouseleyana, from Assam, India, 27 degrees north latitude. *P. pusilla*, a native of India and China. It has a shining black berry, with a sweet, mealy pulp. It is adapted for sandy and otherwise dry and barren soils, but prefers a situation near the sea. This is an elegant dwarf and compact growing species.

P. sylvestris, from India, where it is found in almost all soils and situations. The best specimens are forty feet in height. It is known as the East India wine palm. Sugar is obtained by the evaporation of its sap, which flows from incisions made at the upper part of the trunk just under the crown, a process that does not destroy the tree, but may be continued for twenty years. About eight pounds of date sugar are made yearly from each tree; fifty thousand tons of sugar are made annually from this and some other palms in Bengal alone. This palm has proved a very hardy species in Melbourne, Australia, which has a climate similar to that of California.

P. humilis is found at Kheree, India, in latitude 30 degrees north. The following fan-palms are among the most desirable, and are all hardy:

Chamærops excelsa, from South China, a tall growing hemp palm, the fibers of which are used for ropes. This has proved a very ornamental species in California, having been early introduced.

C. fortunei. This is the Chusan palm of North China. It attains the height of from twelve to twenty feet, the trunk at the base of the leaf stalks being covered by a network of fibers. It is more sturdy in habit than the *Excelsa*, has a rapid growth and endures considerable frost.

C. hystrix, *C. palmetto*, and *C. serrulata*, the dwarf native palms of the Southern States, are all decorative for garden or lawn.

C. humilis, the dwarf fan-palm of southern Europe and northern Africa. It is slow growing, yet makes an ornamental plant.

C. martiana, native of the mountains of India, where it is found at an elevation of five thousand feet. It is a noble palm, fifty feet in height, and would be a desirable introduction.

C. richieana, from the arid mountains of India; has proved hardy, even in England.

C. stauracantha, a native of the table lands of Mexico; would thrive here. These are all of easy culture, and are propagated by seeds or suckers.

The *Livistonas* are also beautiful fan-palms, several of which have proved hardy in California.

Livistona australis, from eastern Australia, where, in East Gipps Land, it attains a height of eighty feet. It has dark green, nearly circular, and plaited leaves. The foot stalks are inclosed at the base with fibrous matter, and armed at the edges with stout spines. The stripped young leaves might be used in the manufacture of hats, etc.

Livistona chinensis, from south China and Japan, is a very handsome species that has been found to be hardy in southern England.

Livistona jenkinsii, from Assam, India; has dark green leaves, fan-shaped, and from two to four feet across; tree, ten feet in height.

Of the large number of *Areca* species, *A. crinata*, *A. lutescens*, from the south of France, and *A. sapida*, from New Zealand, are alone likely to prove hardy.

Kentia baueri, a Norfolk Island palm, and its congeners from Lord Howe Island and New Zealand, are quite sure to thrive in California, with proper treatment. They all reach about the height of forty feet, except *K. moreana*, which is a dwarf.

The wax palm, of New Granada, *Ceroxlyon andicola*, is found on the slopes of the Andes, at an elevation of eleven thousand feet, almost as high as the lower limit of perpetual snow, a fact that warrants its adaptation to the climatic conditions of California. It is one of the most majestic, and also one of the most hardy of all palms, attaining a height of one hundred and fifty feet. The trunk maintains the same diameter as at its base for about half its height, then swells out, and again contracts at the top. A coating of resinous wax is exuded from the trunk, which gives the palm a whitish marbled appearance. It is gathered by cutting down the palm and scraping the trunk with a blunt instrument, the average yield being twenty-five pounds to a tree. It is then melted and run into calabashes, in which state it forms a commercial article. It is mixed with tallow when made into candles, as it burns too rapidly when used alone.

Ceroxylon australe is a species indigenous to the high mountains of Juan Fernandez, at 30 degrees south latitude.

Copernica cerifera is another wax palm indigenous to Uraguay, at 29 degrees south latitude. It attains a height of thirty to forty feet, with a trunk only six to ten inches thick, composed of very hard wood, which is used in building, and is also cut into ornamental veneers. The leaves are fan-shaped and tufted. The young ones are coated with wax, which is obtained by cutting them from the plant and shaking them to loosen the wax. Each leaf furnishes about fifty grains of whitish scaly powder, which is melted into pots and run into cakes. The wax has a lemon-colored tint, and is used for the adulteration of beeswax and in candle making.

Ceroxylon pythyrpophyllum is found in the Andes at eight thousand feet, as are also *Enterpe andicola*, *E. haenkeana*, and *E. longivaginata*; *Diplothinium porallyi*, *Kunthai montana*, and *Geonoma densa*. Thriving in such cool conditions would indicate that these species could be successfully grown here.

Ptycosperma elegans, called in' California *Seaforthia elegans*. This and following species are natives of the warmer parts of Australia. Santa Barbara gardens contain several fine specimens of this beautiful feather palm, that endures our lowest temperature.

Ptycosperma alexandræ, the Alexandra palm of Queensland, Von Mueller describes as one of the noblest forms in the whole empire of vegetation, exceeding one hundred feet in height. The fronds are beautifully arched, quite red when young, but light green when mature.

Ptycosperma cunninghami of east Australia is also a tall species. The two last are introduced in this list with some hesitancy, yet in some of our nearly frostless situations they would probably succeed.

Rhapis flabelliformis, the ground rattan cane of China and Japan, has been introduced, but is yet sparingly planted. It is an exceedingly slender palm, reaching only a few feet in height. The stems are used for walking sticks, and for various small implements.

Of the *Wallichias*, the following should have a trial in California: *W. caryotoides*, in India, 26 degrees north; *W. densiflora* and *W. oblongifolia*, also in India, 27 degrees north, on the slopes of the Himalayas at an elevation of four thousand four hundred feet, growing with the beech and alder. These are amongst the hardiest of all palms. They are not tall, yet are very graceful.

Wettinia augusta and *W. mayensis*, natives of Peru, at an elevation that well warrants their introduction here.

Jubea spectabilis, the coquita palm of Chili, is one of the most remarkable of the family, as this name indicates; growing to a height of from forty to sixty feet, having a straight trunk crowned with large pinnate leaves. The petioles are thick at the base, inclosed in a dense mass of rough brown fibers. It is the most southern of the American palms, and adapts itself readily to our California climate. By a removal of the crown, a flow of sap is kept up for months, each trunk yielding about ninety gallons. This is boiled, producing what is known as palm honey, an article much used by the Chilians. The fruit is round, inclosing a hard, oleaginous, and edible nut, known in the London markets as "little coker-nuts." These nuts are exported by the ton from Chili to San Francisco for the manufacture of nut oil. This striking species should be extensively planted, both for its great beauty and utility.

Cocos plumosa is a native of Brazil, yet has proved hardy in many parts of California. It is a member of the cocoanut family and attains the height of forty to fifty feet, making a highly ornamental tree with long, graceful, pinnate leaves and drooping bunches of waxy flowers, which are succeeded by a profusion of orange-colored nuts inclosed in an edible pulp about the size of an acorn.

Cocos australis is a species indigenous to Paraguay, twenty to thirty feet in height, slow growing and highly ornamental. Its nativity would indicate its adaption to our climate. Much discussion has been had in regard to the probable success in California of the *Cocos nucifera* or cocoanut palm, the multiplied uses of which cannot be enumerated here, and much ignorance has been manifested by those who urge its introduction, of the requirements of this most useful palm. Great heat and moisture together with close proximity to the sea seems to be the requisite. The former conditions are not to be obtained along our coast, for the temperature of the northern ocean current that sweeps along it is too low, influencing the contiguous atmosphere unfavorably to the growth of this palm. Its success is possible in Florida, but exceedingly problematical in California.

There are many comparatively hardy palms that could probably be naturalized in our warmest and most protected districts, a few of which might be mentioned:

Caryota urets, the toddy palm of India; *Borassus flabelliformis*, the Palmyra palm; *Oreodoxa regia*, the royal palm of West Indies; and *Phytelepas aequatorialis*, from the Peruvian Andes, its leaves attaining a length of thirty feet. Palm ivory is largely procured from this species. *Cardoluvica palmata*, of the Andes districts of Peru and Ecuador, furnishes the material for the manufacture of Panama hats.

It will come within the province of the recently established experimental stations of our State to introduce and test these and other species that may become acclimated.

The rattan palms, belonging to the genera *Calamus* and *Dæmonorops*, need to be tested, some of which will no doubt succeed here.

Calamus erectus, *C. extensas*, *C. tennis*, *C. flagellum*, *C. heliotropium*, *C. floribunda*, and *C. montanus* are natives of Assam and other cooler parts of

India. The latter species is found on the Himalayas at an elevation of six thousand feet. This should be tested here. The light but strong suspension bridges by which the rivers of Sikkim are crossed are constructed of this palm. The most durable baskets and canework of chairs are made from its slit stems. In the more tropical regions these flexible palms climb the highest trees, fall again, and rise to other trees, until the stems reach an enormous length. At the Paris Exposition, in 1855, a cane of *Calamus verus*, two hundred and seventy feet in length, was exhibited. The largest canes are seldom more than an inch in diameter. The Japan and China species would also prove hardy here. Much of the beautiful basket work of those countries is made from thin strips of cane.

The list presented is by no means complete, but a sufficient number of species have been mentioned and described to enable an intelligent planter to select those that require the least care and protection. As yet we have drawn but sparingly upon the prodigious resources at our command. With proper storage reservoirs to conserve the annual rainfall, and a well developed system of irrigation in our more arid districts, California may become under such sunny skies, a tangible paradise. With our grain fields, vineyards, temperate climate, and semi-tropical fruit orchards, nut plantations, and flower gardens, interspersed with such tropical aspects as may be effected by a judicious selection of palms, bamboos, fourcroyas, bananas, and agaves, adding in a marked degree to those pleasures of the eye that spring from variation and contrast of form and color, we can render our heaven-favored land a veritable Eden, toward which the footsteps of our blizzard-frozen and cyclone-twisted brothers and sisters of the East will ever tend.

THE HORTICULTURAL RESOURCES OF CALIFORNIA—SOUTHERN CALIFORNIA.

Essay by T. S. Van Dyke, San Diego.

When I look back but seven years upon the products of this part of the State, my confidence in my ability even to imagine the future is seriously shaken. But when I look back still another seven years to the time when I first came here, that confidence vanishes entirely. Bold, indeed, must he be who, in the light of the past, should dare to assign limits to the future. No country has ever, in so short a time, reversed so many judgments passed upon it by experts as Southern California has; no country has ever so agreeably and so greatly surprised even its oldest settlers and its most enthusiastic friends. The more one follows its ever brightening lines of progress, the more one is surprised at their number and the less one knows about the dim future toward which they radiate. Fourteen years is but a step in the grand march of improvement; yet, in that short time, what changes we have seen.

Who can look back without a smile upon the best oranges of which we boasted but fourteen years ago? Sour, dry, light, insipid, thick skinned, and dirty; they were oranges only in name. To-day we have all these conditions reversed, and our oranges command the markets of the whole country at a price that few ever dared to hope for. The huge mass of skin, dry, spongy, and bitter, that in those days was called a lemon was even a more cruel hoax than the orange. To-day, though we have some important points to learn in picking, curing, and packing, Southern California can equal the world in quality, and could shortly, perhaps, equal it in quantity.

Improvements almost as marked have been made in all other directions, and still the improvement goes on.

Equally rapid and decided has been the improvement in curing and packing. We knew, years ago, that we could produce in perfection almost every variety of grape, but how long is it since a "California raisin" was an object only of contempt? But yesterday they were scarcely worthy the name of "dried grapes;" to-day they have conquered the market of America, and are commanding the respect of the connoisseurs of England. So, too, we knew long ago that the prune would thrive here, yet it seems but yesterday when a good dried prune was so scarce as to be merely a curiosity, giving some hope, indeed, of the future, but still such a rarity as to be more of a suggestion than a demonstration. To-day California prunes, as good as the best of Europe, abound in almost every home grocery. This same improvement extends to everything, and our people are also learning in a day what Europe learned only by ages of experience, that an honest pack and an honest brand are necessary to capture and hold the market.

Quite as great as any has been the advance in cultivation and irrigation, by which not only has the quality been improved, but the yield has been largely increased. The old system of repeated flooding, by which water was made too much of a substitute for cultivation, has nearly passed away, and the old style of cultivation which was used only to kill the weeds, has been generally supplanted by the vigorous and constant summer cultivation which is so effective in retaining moisture. The plow, too, runs several inches deeper than it did five years ago, and cross plowing, then almost unknown, is fast becoming common. The consequence of all this is a heavier yield of far better fruit with from one fourth to one tenth of the water lately deemed necessary here, and still thought necessary by the great world. Irrigation is a science, and though the world is not yet aware of it, it owes much to those who have so developed its wondrous powers in Southern California, as for instance, at Riverside and Redlands. By many irrigation is considered a drawback. On the contrary, it is a blessing, and the sooner it is adopted by any section not having an abundant summer rainfall, the sooner will that section unfold its fullest powers and surprise even itself. Irrigation means to a great extent the control of the water, it being almost as important to keep it off when not wanted as to put it on when it is wanted. The more nearly such control approaches the absolute, the greater and better the result. In the greater part of Southern California, irrigation is not a necessity except for the best results. But, it was long supposed to be an absolute necessity for any results, and to this fact is principally due the great advances we have made. It has been proved an auxiliary that few can afford to ignore, and another century will see its use in the majority of even those eastern States that now look with contemptuous pity upon a land where they have to irrigate.

One thing that has been a drag upon our pace is the idea that this is not a poor man's country. The last few years have shown this to be a mistake, however true it may have been in the past. There is, perhaps, no country upon which such a diversity of production is possible, and none that responds more quickly or generously to the touch, so that the land is now covered with prosperous homes of men of very small means, who, on a small piece of ground have made a living from the soil the first year, planting vineyards and orchards gradually by their own labor. Some of the most profitable vineyards and orchards now to be found have been thus planted and cultivated by the owner's own hand, the place and improvements earned and paid for out of the land itself, the family being supported meanwhile in comfort. This class has now joined the wealthy class in bearing along the standard of improvement; every year the number of their imitators increases, and the end no man can foretell.

The amount of land available in Southern California for the production of all kinds of fruit is a thing that few even of its oldest residents have any idea of. Unless one keeps constantly exploring it one knows little. It is a land that is constantly expanding, expanding each year at a faster rate than the year before. Every year sees thousands of acres of vineyard and orchard shining upon land that the year before every one supposed Nature had designed only for brush or cactus. Every year sees thousands of vines and trees come into the full bearing of abundant and perfect fruit upon gravel and bowlder washes, wastes of cobble-stones, etc., that but three or four years ago the poorest seeker for a home on the public lands would not touch. So every year sees water brought higher and higher over the country, and thousands of acres which must have irrigation, and which with water are the most valuable parts of the whole, are being yearly reclaimed. In spite of decisions that forget what the law of England would have been had she the dry summer and the mountain streams of California, that doom millions of public wealth to eternal waste to gratify the dog in the manger that would hang up high and dry for all time a thousand acres of the finest lands in the world in order that the water may in imagination stand an inch or two higher upon the grass roots of one acre of bottom land already too wet, in spite of ignorance of the land and the land's necessities, in spite of expense, in spite of physical difficulties, Southern California is getting more water than ever before; and, especially in San Diego County, is entering upon an era of water development that will cast the past into the shade. This is of far greater importance than the discovery of new land, for it is the irrigated sections that will produce the greatest amount of wealth and maintain upon the market the highest standards of our products.

No living man knows Southern California, or even one county of it. Los Angeles County wears more of her jewels upon her breast than any other county, yet the man who thinks he knows even that county is badly mistaken.

San Bernardino County is even more deceptive, and San Diego nearly every one is deceived about. I know nothing more singular in the history of civilization than the dogged persistency with which the world in general, and that part in particular which would most profit by its rapid development, has ignored the great resources of San Diego County. Doubtless some of you will smile at the statement, but most of you will live to see the time when people will cease to judge of this immense county by a glance from the car window, or the deck of a steamer, when it will be the pride of California, and be ranked among its five wealthiest and most productive counties, when it will have, outside of cities and towns, the largest population of producers of any county in the State, with the possible exception of Los Angeles County. I am fully aware of the boldness of this statement, but it is made with full deliberation, and the fullest knowledge of the subject.

The area of land available for fruit growing in the five counties which include all that is generally called Southern California, is about three million acres. This does not include any of what is known as the Mojave or Colorado desert. Upon these deserts are vast areas, of which the quality of the soil is good enough, and which will some day be reclaimed by water, which is there indispensable, but which cannot fairly be included until in some way the water question is settled. These deserts, like many other deserts of the past, will some day surprise the world, but their possibilities are too remote for consideration here.

Of these three million acres * lying on the western slope of the land and under the Pacific rain belt, about five hundred and fifty thousand acres in the County of San Diego, three hundred thousand in the County of San Bernardino, six hundred thousand in the County of Los Angeles, three hundred thousand in Ventura, and three hundred thousand in Santa Barbara County—over two million in all—are soil that would be called first class in any State or under the sun. Ten years ago it would have been conceded such by the most prejudiced sneerer at the "cow counties" who could have laid aside his conceit long enough to examine it. The remaining million is land that any one ten years ago might justly enough have pronounced worthless. But the world has moved since then, and it has been discovered to be as good as any land for many of the most valuable fruits, while the elevation of most of it above the line of killing frosts makes it specially valuable for many things.

The rainfall in the south follows elevation the same as in the north. Fully one half of the above acreage lies upon a rain belt as heavy and reliable as any of the valleys in Central California, and its yield of wheat and barley upon the natural rainfall alone will, for any ten successive years, equal the yield of any part of the world for the same period. Yonder long lines, thirty miles away in the eastern sky, that look to you like bare, rocky ridges, so closely huddled that arable land between them would be an impossibility, are but the broken outlines of an elevated country, lying from two thousand five hundred to six thousand feet above the sea, and containing some two hundred thousand acres of rich, deep arable land, upon no part of which during the twenty years it has been settled has there ever been a failure of crops, except from too much rain. Within forty-five miles of you are thousands of acres of heavy pine timber, with hundreds of sugar pines from five to six feet in diameter, and hundreds of springs and running brooks pouring cold water the long summer through. Even as low down as fifteen hundred feet full crops of grain were cut in 1877 and 1883. The Government gauge at Fallbrook, but seven hundred and fifty feet above the sea, and but twelve miles from the coast, shows about the same rainfall as Los Angeles, and that of Los Angeles differs but little from that of Sacramento. The idea that Southern California is a dry country is a mistake. Some parts of it are too dry in some years, but much of it has always enough rain, and the greater part of the remainder has enough in about nine years out of ten. When the rainfall is too light upon this area the best sections of the north have little advantage to boast of, while Southern California in some years has local rains that do not reach the north.

Of this three million acres probably five hundred thousand are too damp for fruits that, like the orange and lemon, are injured by the roots getting into standing water. Where very damp, this makes good corn and alfalfa land, or pasture land, which is very desirable in any country, and where not too damp, grapes and some trees, such as the fig, seem but slightly affected by the change of water level on their roots. Of the remaining two and one half millions probably one million will, within the next twenty years, be made capable of irrigation. There are now about two hundred and fifty thousand acres supplied with water exclusive of irrigation from wells, though all of it is not yet cultivated. Exclusive of the five hundred

---

*The accuracy of these figures have been doubted. The Los Angeles "Daily Herald" claims that the number of acres claimed for San Diego County is too large, and says: "Of the upwards of three millions of acres of Los Angeles County quite one million five hundred thousand acres are perfectly adapted to fruit culture now, without the necessity of developing water."

thousand of damp lands above mentioned there are fully five hundred thousand acres of upland that cannot be said to need irrigation at all. They already produce upon the natural rainfall, aided by good summer cultivation, a better yield of fruit, and of better quality, than any land would do in any eastern State, and of this area some two hundred thousand acres lie in the mountains of San Diego. Upon five hundred thousand acres, more results are constantly obtained without irrigation, that, with hard work and close economy, enable a man to make a better living from eighty or one hundred acres than he could make from one hundred and sixty in any eastern State. This is more like common farming, but has been done for years and can be seen anywhere. Much of this acreage will, in time, be irrigated in some way which will quadruple its production; but if it is not, it will still be as valuable a factor in future prosperity as it unquestionably is to-day.

There are about half a million acres more upon which oranges, lemons, or deciduous fruit would be a practical failure without irrigation and which are not likely, in this generation at least, to be supplied with water. But the wine grape and the olive do well upon these lands, and if in occasional years the crop be shortened some for want of sufficient rain, the difference is offset by the cheapness of the lands and the slight care these fruits require.

These estimates are not made without full knowledge of what the expression three million acres means. It is about one sixty-sixth part of the whole cultivated area of the United States in 1880, and equal to one half of the average State of our Union at that time. In view of its productive power it really means far more.

These three million acres lie at such varying distances from the coast, and varying elevations above sea level, that the widest range of production is possible. The English walnut, that demands a deep, rich bottom soil, can be easily accommodated in some part of the valleys, while for the orange and lemon, that are content with a thinner soil, but more exacting in the matter of climate, there are acres of slope and upland by the hundred thousand. The apple, that demands a winter climate more like that of the East, reaches the highest perfection at three thousand to six thousand feet above the sea, fully equaling the best apples of New England. The cherry and almond, that fail to fruit well near the sea level, are loaded with the finest fruit in the mountains. In like manner every kind of fruit finds a place where it reaches perfection, and yet over the greater part of the land nearly all kinds may be grown together upon the same farm with an approach to perfection sufficiently close for profit. And yet nine tenths of all this will raise almost equally well all kinds of grain, vegetables, and coarser produce; so that ordinary farming may be carried on in connection with fruit growing, and on account of the mild winters and perfect summers may be carried on more cheaply and profitably than in most of the eastern States.

I have referred more particularly to these facts, because the great world thinks Southern California a land only of town lots and climate, with a few small narrow valleys containing a few fancy farmers, sandwiched in between leagues of desert mountain. It is a land supposed to live upon booms, with few resources except the money brought in by periodic excitement. On the contrary, its great resources alone made the boom possible. The boom was a result of the rapid growth which the discovery of these resources by wealthy people from the East had for years been producing at a constantly increasing pace. The great boom was merely a misdirected acceleration of what had been a healthy growth. The growth still continues, and he who thinks he can see the end of it will change his mind after a few weeks' travel throughout the land. San Diego County, outside the cities, has never grown as fast as within the last twelve months, and the other counties are growing quite as fast as at the beginning of the boom.

Of the quality of Southern California fruits it is idle now to speak. They have spoken too long and too well for themselves to need anything more. They have been tried so long on so many kinds of soil and under so many different climates that it is now certain that two thirds of the country may be turned into orchards and vineyards, whose products the world cannot excel in either quality or yield. Consequently there has been little left for me to do in this paper but show the area available for fruit culture, with the rainfall and irrigation facilities, and correct some very gross mistakes which the great world seems to take special delight in making. The labor question will present few or no difficulties here, because the tendency is and always will be to cut up and subdivide. There will be few large orchards, and most of the producers will do the greater part of their own work.

Can the market be drugged? Why borrow trouble in advance? The market is constantly expanding and will expand faster and faster, the faster good fruit is thrown upon it. The surest way to keep the market is to furnish it the best there is, and the man who does so will always make money. The time may come—may the Lord hasten it—when poor stuff will not pay, but the market will never be drugged with good fruit, well packed, and of uniform quality throughout the box.

Southern California has been extremely fortunate in having a far larger proportion of wealthy immigrants than any other land has ever seen. But for this fact the great results could not have been worked out against such heavy and numerous discouragements as the experimenters battled with for years. But they had come to enjoy the climate, no matter what it cost them; they wanted amusement meanwhile; they had faith in the final outcome of their labors, and they were able to wait. The collapse of the town-lot bubble has had little effect upon the coming of this class, and their continued coming may be counted upon as surely as the rising of the sun. If the land has made such progress when there was no paying market and only the wealthy could afford to play with fruit growing, what shall we see now that a sure and profitable market awaits almost everything we can raise and properly pack, and the poor man can plant his own trees and vines, and make a good living from the soil while he is waiting for them to come into bearing?

RESOLUTIONS ADOPTED.

Resolved, That we, the fruit growers of California, in Convention assembled, tender our representatives in the California Legislature (twenty-eighth session) our sincere thanks for the kind and due consideration the horticultural interests of California received at their hands.

Resolved, That the members of the State Board of Horticulture and the members of the State Horticultural Convention desire to express their gratification in the vast and comprehensive work in forest and ornamental planting now in progress at the seat of the Leland Stanford University—a work which comprehends every known tree, shrub, and plant known to botanists, which may be grown in California, and their pride in the fact that it is in the power of a single citizen of our State to confer so vast a benefit upon the country of future generations.

Resolved, That the thanks of this Convention be and they are hereby tendered to the officers of the State Board of Horticulture, for the very able and intelligent manner in which they have conducted this meeting.

WHEREAS, The people of National City invited the fruit growers of the State to assemble in their midst to hold the eleventh session of the State Convention; and, whereas, the fruit growers, through their State Board of Horticulture, accepted such invitation, and came here in large numbers to discuss questions of vital importance to them, and at the same time to study the resources of this section so far as fruit growing is concerned; and whereas, on their arrival here they were welcomed in a hospitable manner rarely equaled and never excelled by any people on the face of the globe; and, whereas, the courtesies extended to visitors have been on a scale to astonish and gratify all of us; therefore, be it

Resolved, That for the kind and whole-souled reception extended to us, we hereby desire to be more than formal in extending our most profound thanks.

Resolved, That these resolutions be engrossed and signed by the officers of this Convention and presented to the Chairman of the Committee of Reception as our emphatic and lasting testimony, that we mean just what we say.

WHEREAS, The officers of the motor and belt lines of railroad, National City and Otay Railway and Coronado Railroad Companies have, with great kindness, extended the free use of their lines of roads running in all directions, steamed up, manned, and ready for horticulturists' orders from that worthy rustler, Frank A. Kimball, to go here, there, and everywhere at a moment's notice; therefore,

Resolved, That we extend to them our heartfelt and pocketbook thanks, and not a one and one third round-trip gratitude.

WHEREAS, The great railroads, "The Old Reliable," the Southern Pacific, and the "Get There," the Santa Fe route, have extended the usual excursion rates; therefore,

Resolved, That we, the delegates of this Convention, return our most grateful thanks.

Resolved, That these resolutions be spread upon the minutes, and copies of the same sent to the officers of the said roads.

Resolved, That the horticulturists of California, in Convention assembled, deem the establishment of a national forestry system of the greatest advantage and necessity to the State of California, and recommend and request their representatives in Congress to aid in the establishment of the same.

WHEREAS, We have assured ourselves of the following facts (approximately), to wit: That it takes 57 cents per box (by carload lots) to transport oranges from Florida to New York City and Boston; that the average yield of an acre of orange trees in good bearing is two hundred boxes per acre; that the transportation of a box of oranges to New York City or Boston from Italy is 25 cents, and the United States revenue tax (import duty) on said box is 25 cents. Thus the expense of a box of oranges from Florida to New York City or Boston is 7 cents greater than from the ports of Italy; thus it costs $14 per acre more to deliver oranges from Florida, *i. e.*, two hundred boxes at 7 cents equals $14 per acre advantage for the Italian subject and orange grower over the Florida citizen and orange grower; and whereas, common labor in Florida is worth $1 per day and in Italy 20 cents per day, thus one hundred acres cultivated in Florida costs: ten men one year, three hundred days, $3,000, ten men one year, three hundred days, in Italy, $600; $2,400 difference, this being $24 in favor of Italy per acre in labor; therefore, on the question of transportation, Italy has the advantage over Florida transportation and import $14 and on labor $24, total $38 per acre; now, therefore, as citizens of a sister State, we tender to Florida our sympathy and ask our Senators and Congressmen to aid the citrus growers of that State by judicious legislation; and whereas, the transportation of a box of oranges from California to New York or Boston is $1 25 per box (by the carload lots) and to Chicago is 90 cents per box, and labor in California is $2 per day, therefore the Italian orange grower has the advantage over the California orange grower in New York of about $76 per acre. In the Chicago market the Italian has the advantage of California $58 per acre. That, to our mind, King Humbert is able to protect his own subjects, and we appeal to the United States Government to protect us and not the subjects of Italy; and whereas, when we calculate the protection on oranges and lemons, we find: on oranges 8 per cent, on lemons 8 per cent, on potatoes 33 per cent, on oats 25 per cent, on rye 18 per cent, on corn 16 per cent, on wheat 20 per cent, on hops 50 per cent, on butter 17 per cent; and whereas, we consider our brother cultivators of the soil and all our fellow citizens in all the States do not desire the fruit grower and vegetable grower of the United States to be less protected than in their various avocations; now, therefore, be it

Resolved, That it is the sense of this Convention that Florida and California, as near as can be, should be placed on an equality with Italy, and to do so, that from the fifteenth day of November, of each year, to the fifteenth day of June, of each year, the import duties on oranges and lemons be $1 per box, and for the other months of the year be 50 cents per box.

Resolved, That the State Board of Horticulture be requested to arrange for the fall meeting of the Fruit Growers' Convention this year at Fresno.

Resolved, That we, the delegates to the annual Convention of California Fruit Growers, held in National City, San Diego County, California, under the auspices of the California State Board of Horticultural Commissioners, do hereby petition his Excellency, the President of the United States, and the honorable Secretary of State, as follows: Respectfully and earnestly petition that a series of new questions may be formulated for the direction and instruction of American Consuls, by which every information may be obtained in regard to all the fruits of the various foreign countries—which it is probable may be cultivated within the limits of the United States—and that our Consuls and Consular Agents may be directed to report at regular and stated periods in regard to fruit pests and the methods used abroad in their extermination, and that our Consuls may likewise report as to the packing, curing, preserving, and manufacturing of such fruits, plants, and plant products as are grown in those older countries that have been under cultivation for hundreds of years, or in those newer countries when the products may prove of especial value to our entire nation, and of great and especial benefit to the citizens of California.

Resolved, That the Board of Horticulture be earnestly requested to petition the honorable Secretary of Agriculture at Washington to send a special agent to Australia, whose knowledge and experience shall fully qualify him to collect and export into this country such parasites as are there found to be destructive to the various scale insects which have been imported here, and are now disastrous to our fruit interests.

XXXII.

SYNOPSIS OF PROCEEDINGS OF THE TWELFTH STATE FRUIT GROWERS' CONVENTION.

[HELD UNDER THE AUSPICES OF THE STATE BOARD OF HORTICULTURE AT FRESNO, COMMENCING TUESDAY, NOVEMBER 5, AND ENDING FRIDAY, NOVEMBER 8, 1889.

The Convention convened at the Rigg's Theater, and was called to order by the President, Hon. Ellwood Cooper.

The exercises were opened by prayer by Rev. N. R. Peck, of Penryn.

The following Vice-Presidents were chosen: J. W. North, of Fresno, and W. H. Aiken, of Wrights, Santa Cruz County.

OPENING ADDRESS.

Hon. Ellwood Cooper, of Santa Barbara, President of the Convention, delivered the following address:

LADIES AND GENTLEMEN: This will be the twelfth State Fruit Growers' Convention and the eighth held under the auspices of the State Board of Horticulture.

At the last Convention, held in April, at National City, there was a larger attendance than at any previous one. We have not only to report better attendance, but greater interest manifested at each succeeding Convention. The increased demand for our reports is very encouraging, because it shows the progress of the horticultural work. We have issued ten thousand copies each of the transactions of the Chico and National City Conventions, and will have ten thousand more in the biennial reports, making twenty thousand issues of these Conventions, which will not be sufficient for the demand. I would suggest that there be a special edition of the biennial reports, commencing with that of 1885 and including the present. A portion could be left out without injuring the work as a horticultural reference; and all could be bound in one volume. Authority should be given to the Board to sell this work for a fixed price, so as to satisfy the demand that comes from foreign countries and sister States of this country. Many urgent appeals are made to us for our reports from fruit growers without our State, to whom we cannot give them, having no authority to do so.

I regret that I cannot report so favorably for the fruit crop of this year, as I did in my opening address at the Santa Rosa Convention, two years ago.

The product of many of the fruits in almost every part of the State has been small, and in my locality, Santa Barbara County, exceedingly light.

The prunes and some of the plums did not leaf out until August. Some varieties of apples, while they had a fair crop on limbs and branches near the trunk, on the ends of the limbs did not bloom until August, when new leaves started. The olive trees, while showing abundant bloom buds, have borne but little fruit. About one half of the walnut crop was burnt up by an extraordinary heat that passed over the locality on the twenty-seventh of July, lasting from about sundown till midnight. Nearly all fruits were burnt on the southwest side. Such a blasting heat has not been known since 1858, when a similar simoon passed over the same locality in June, the effect at that time being worse by reason of the earlier period in the season.

It is most gratifying to report that the *Vedalia cardinalis*, known as the Australian ladybug (or beetle), has practically settled the question of the ravages of the *Icerya purchasi*. A partial description of this ladybug will be found in an essay by Professor Coquillett, in the report of the National City Convention. At that time it was yet too early to know the result of the work of this parasite. The marvelous increase of the Vedalia and the rapidity of its work is almost incomprehensible. Whole orchards infested with Icerya have been cleaned, and there does not appear to be a doubt but that, by the end of another year, there will be no Icerya to be found in the State to do injury.

The work of this little ladybug should teach us a lesson of humility. While the orange and lemon growers have been struggling in various ways against the ravages of the Icerya, only to see it gradually increasing in spite of their efforts and expenditures, all their funds being exhausted, with their orchards not bearing and a hopeless future before them, at the opportune moment this little, apparently innocent ladybug comes to the relief and saves them.

I strongly recommend that there be a large greenhouse built to cover two orange trees, with a tight partition between the two trees, and that the Icerya be allowed to breed upon one and the Vedalia on the other. The Vedalias could be fed in such a manner as to secure there always being some on hand for distribution in case they were wanted. There is no probability that all the scales will be destroyed; some will be left to increase and spread again, unless the Vedalias are at hand, and there is no certainty that the latter can always be obtained from Australia or New Zealand. The risk is too great to take any chances, especially where the cost of keeping these ladybugs would be so trifling. I also recommend that our efforts and bulk of expenditure be made in searching for and breeding predaceous insects for other scales that are doing so much injury to our fruit products. In recommending this mode of warfare, I beg to call your attention to an essay written by Felix Gillet, and published in our first report in 1881. Mr. Gillet was a member of our Board.

"But the simplest and most efficient way of fighting the codlin moth, and all other like pests, and fighting them all round at the same time, without any rules to be enforced, ought to be to pitch against them the ichneumon flies. When we consider what immense services these hymenopterous insects do render to agriculture—when in numbers large enough

to do any good—it is surprising that those States that have spent already such large sums of money to fight noxious insects, and that have lost still more through their depredations, have never tried to raise ichneumon flies by the million, and let them loose wherever there are any insect pests to destroy. Why, in fact, should we not raise predaceous insects to fight noxious insects? If we want to imitate nature, and it is the best thing we could do, why not do like her, and hurl the ichneumonidæ against all those pests?" * * * "I am well aware that such a result cannot be obtained without very long and tedious efforts; that we would have first to call to our help the entomologist's services; educate our people on the importance of acquiring a certain knowledge of the natural history of insects; call for the aid of the State to establish stations where to raise the predaceous insects, and teach the farmer and his sons how to do it themselves. Let me tell you that this question of insect warfare has never yet been properly handled. As well in the old world as in the new, it is altogether in its infancy, and here we have to depend mainly on ourselves, so little have we to profit by the experience of all other countries on this vexed insect question, of such vital importance to the agriculturist and horticulturist of California."

Next to the Icerya, I consider the *Coccus olea* or *Lecanium olea*, the black scale of the olive, the most dangerous and hardest to manage. Our success in the discovery of the Vedalia ought to encourage us in the hope that we may yet find some parasite equally destructive to the black scale, and I might also include the red scale and San José scale; in fact, all scale insects. I have reason to believe that Australia and New Zealand are the homes of all these insects, and that their enemies are to be found there. Australia was known as early as 1598, but it was through the voyages of Captain Cook, from 1769 to 1777, that much was known of that country. In these voyages there were more or less plants carried from there back to Europe. The earliest appearance of the black scale in Europe was in 1743, according to Lejourdon; 1781, according to Abbe Conture, and in 1783, according to Bernard. The last writer states that all the Roman authors of the first half of the eighteenth century were silent upon this subject. It is certain that a malady, so characteristic with such a disagreeable aspect, could not have escaped the observation of authors. I refer to my essay on the diseases of the olive, published in the first report in 1881, page 35.

Before leaving this subject, I would suggest that some substantial token of our regard be presented to Mr. Albert Keobele. Such action would be a proper stimulant to future searchers. It would be just, for the reason that he was exposed in localities of intense heat while hunting for parasites, and was reduced to a malarial condition that cost him much time and money. It is true that he was sent by the Government, and was there in the performance of his duty. The result of that performance was our gain, and while others might have performed the service equally well, it was his whose success must be recorded, together with Professor Coquillett, who received, cared for, colonized, and distributed these invaluable insects. This was no work of chance, but the result of scientific knowledge, careful training, and a conscientious duty intent upon the object to be attained.

At the National City Convention, I recommended fruit inspection, also that the railroad companies guarantee the time our fruit shall be in transit to eastern markets. Since that meeting I have had no reason to change that opinion. I therefore advise that committees be appointed to secure lower rates of freight and guaranteed time in transit. I was also impressed with the importance of a better distribution of our fruits. I call your attention to that address.

At the American Pomological Society, held at Ocala, Florida, in February last, the importance of this subject was very prominent in their proceedings. In his address, the President says: "When an industry or source of production is left to individual resources, so far as aiding in its development, its progress is necessarily slow and often unremunerative; but when many men combine their knowledge and efforts with a desire to advance its proficiency, then it is no longer dependent upon the toil of one individual, and thus toil may be made to be no longer without its concurrent reward. The problem of utilizing surplus fruit has been for some years a practical subject for the consideration of American fruit growers. While an overproduction is likely to occur at times, and with certain products, there are beneficial concomitant results. An abundant supply of cheap fruit brings the latter within the reach of those whose circumstances debar them from its constant use, and soon creates a habit that changes to a necessity, and a more ready disposal is the consequence. The perfection attained in producing evaporated fruit would demonstrate that when an oversupply can thus be converted into a wholesome article of food, easily preserved for future use, we are safe in extending the planting of such fruits as can be thus utilized. As the foreign demand is increasing for American products, it is to be anticipated that still greater improvements will be made in the methods for their indefinite preservation."

In the same proceedings, in an essay by Barnett Bros., of Chicago, they say: "The general lack of information and disregard of the movements and operations of others is one great source of uncertainty in the results. A market to which a large or small number of shippers are sending their produce, can take care of only a certain amount at remunerative prices. Each shipper acts as though he considered himself almost the sole source of supply to that market, and ignores absolutely any new source of supply, and considers his own as the supply. In this connection we may mention that the demand, the purchasing power of the markets, is seldom studied with the care that should be exercised for the proper prevention of oversupplies."

During the past year our advance in knowledge and the better management of our fruit products is encouraging. There has been less waste; the information on the different processes of drying fruits more extended, with better methods in their preservation; the prune industry has been prosperous; the fig has elicited more attention in some localities than any other fruit, and encourages us in the belief that we have a market that will warrant extensive planting. The raisin industry has received a check in the "vine disease," that is spreading with alarming rapidity, and leaves us in doubt as to the future of vine planting. The high prices now existing for dried peaches and dried apricots, ought to convince us that the culture of these fruits is not overdone. I might extend my remarks with a favorable report of all the fruits grown in California, but will close by calling your special attention to the two greatest problems with which we have to deal: *Insect pests* and *the distribution of fruit*.

I submit these suggestions for your consideration.

ADDRESS OF WELCOME.

Delivered by E. J. Griffith, of Fresno.

Mr. Chairman, Ladies and Gentlemen: I have been selected by the Fresno County Board of Trade and the citizens of this thrifty young city, to extend to you, on their behalf, a hearty welcome to such hospitalities as we have to dispense.

I feel that I am scarcely equal to the duty, therefore I trust you will accept the will for the deed.

I was requested, in fact instructed, to most heartily welcome your coming into our midst, and in the name of the people of the City of Fresno, of the Fresno County Board of Trade, and of all the citizens interested in the industries which are here to be discussed, I extend to you this hearty welcome, and deliver to you, so far as we are able to do so, the keys of this city, and I express the wish and the hope that your deliberations here may be of incalculable benefit to the great industries of the State of California.

You do yourselves credit, and you do the State of California honor in devoting your money and your time, exercising your brain, and putting into operation every means known to intelligent men and women, to make the most out of the immeasurable opportunities which the people of California enjoy. It is natural for us, who live in California, who have adopted California as our home, and especially natural for those of us who were born upon these shores, to feel a personal pride in the progress of our State.

No State in the Union is comparable to California in the matter of the quality and quantity of its products; diversity and fertility of its soil; variety and salubrity of its climate.

It has been said by a philosopher that "life is not measured by years;" men may live till their heads become hoary with the snows of seventy winters, and yet they may not have lived—they existed per chance. Life, therefore, is not measured by years, but by realizations, by a succession of ideas, by glorious experiences. These are the things, and these alone, that make life real and earnest, and give to it that zest which God intended every man should enjoy.

The trees that protected me from the summer sun of the old Dominion, the brooks beside which I played when a boy, the paternal roof beneath which my earliest years were passed, are still dear to me, and with these are clustered ten thousand pleasant associations. Notwithstanding these things, since life is not measured by years, but by experiences, realizations, and a rapid succession of ideas and events, sixty years beneath these skies, on these shores, yield more of life than eighty years in any State beyond the Rocky Mountains.

The butterfly, born upon a beautiful morning in June, that, with particolored wings, floats through the transparent air and sips the nectar from a thousand varieties of flowers, during one brief day has lived longer, when the sun goes down behind the western sea and its life goes out, than the slow-breathing turtle of a hundred years.

But you have to do with propositions which concern the material welfare of this State, which have to do with the prosperity and happiness of every citizen of California.

You have to do with propositions which are to determine and which are now determining that California is destined to be the richest and most populous State in the Union. Within the borders of the County of Fresno, with the aid of manufactures, there are resources sufficient to support in comfort, even in luxury, every man, woman, and child in the State of California—more than a million souls. This does not seem extravagant, when it is remembered that we have an area of sixty by thirty miles divided into small holdings, already under an organized system of irrigation, both direct and indirect, and a soil of most marvelous fertility, with capabilities superior to the soil of Egypt in the days of the Pharaohs, and a county area equal to the great State of Massachusetts. We will not see the day—I trust we may not—but the time is coming when California will support thirty-five or forty millions of people. It is needful, therefore, that every man and woman should bring his best talent and genius to bear upon the development of our incalculable resources. As shown by the statistics of the United States, our population now, including immigration, is doubling itself every twenty-five years. We have now in the neighborhood of seventy millions of people in the United States. In revolutionary times we had about three millions of people in this vast domain. Now seventy million, and in twenty-five years, according to the statistics, we shall have one hundred and forty millions of souls, and unless we close down the gates of immigration (I make no political allusion here) something must be done speedily. We must support our people, those who come and those who are born here. Fifty years from now our population at the present rate will be two hundred and eighty millions! Since our population is growing so prodigiously it will become the duty of the great State of California to support a very large number of this tremendous population.

There is a grand future for California. I have traveled and observed somewhat, and I declare that I have never been in the midst of a community engaged in rural pursuits so intelligent and so progressive as the people of California. We have more gentlemen farmers, in the high sense of the word—men of education, men of culture, men of thought, men of reflection, men who are looking to it that every square yard produces the best possible result, both as to quantity and quality—I say we have more of these men and women in this country than any other country that I have had the pleasure of visiting.

I desire to call your attention to the great importance of preserving from destruction the forests which cover the various watersheds of this State where the snows fall. These are the sources of the streams which, flowing down through the cañons and mountain gorges and debouching out on the plains, fertilize and render productive our lands.

It may seem strange to you, but think of it a moment; about sixteen years ago the great valley of the San Joaquin, one of the most splendid valleys in the world, destined to become one of the wealthiest, most populous, rivaling ancient Egypt in all her glory, both as to the quantity and quality of her products, and, certainly capable of surpassing her in the arts of civilization, was a desert waste. She has no pyramid of Cheops to build; but her farmers, with cultivated brain and brawny arm, within the shadow of their own vine and fig tree, and close to the domestic hearthstone, have to build, and are building for themselves, their families, and country, grander and more enduring monuments—monuments which will transmit honored names to posterity.

By your permission, I desire to especially refer to the growth of Fresno County. Ten years ago, the City of Fresno was a mere village, containing but a few hundred people. There were only three brick buildings—small ones at that—in the town. There were no other brick structures within the limits of the present city; the population of the county was about eight thousand five hundred, and the village has grown to a city of twelve thousand population.

The county population has increased to forty or forty-five thousand. The wealth of the county was from six to seven millions, which has since grown to thirty-eight millions of dollars of taxable property. All of this country was a pastoral country; shepherds had possession of this vast domain; not a vineyard in all the land round about, not a fig tree under which to rest from the rays of the burning sun, not a single stream flowing across these plains to quench the thirst of the famishing traveler, not a home adorned with a flower garden, or with a tree or anything to relieve the eye or to cause the traveler to believe that there was any future whatever for this country; the ground squirrel, the horned toad, the rattlesnake, and the coyote had possession of the land. Only about sixteen years ago the first water was diverted upon these plains. Since that time a most wonderful change has come. The sheepherder who has grown white in the service, and, Rip Van Winkle like, had fallen asleep, woke up one morning just after Mr. Church had constructed the first canal, and lo! what a transformation!

Where but yesterday were desert plains and boundless deserts, to-day were blooming orchards and evergreen alfalfa fields, palatial homes, long, extended, and well shaded avenues, beautiful gardens, parterres of flowers. It seemed as if the enchantress herself had come, and so she had. For long years, and for centuries it may be, the waters of the mountains had been wooing and courting the valleys and plains that lay below. It was through the genius and the enterprise of men who had confidence in the fact that God made the water for the land and the land for the water, that they went into the mountain and to the riverside and dug a trench wide and deep, and the plow and the shovel of the earnest and honest laborer were followed and pursued even down to these plains by the refreshing waters, and lo! the bridegroom came, and the water and the land were married and made one.

I tell you, the priest who performed that ceremony endeared himself, not only to his own, but to all the coming generations. It is of interest to this Convention and every man engaged in agricultural or horticultural pursuits, and, in fact, as I understand it, it is the business of this Convention to consider all matters that tend or conduce to the growth and prosperity of this State.

The means to be called into requisition for the preservation of our forests are well worth the consideration of this Convention. Something must be done that the great valleys of the San Joaquin and Sacramento, and all other valleys in the State, may subserve nature's designs, and yield to man the vast treasure so long concealed.

I heard several members of this Convention, last night, as I came from San Francisco, say that the development of the southern half of California was simply phenomenal; that they had never seen a development comparable to it; that they were beginning to feel that Northern California should bestir herself, and call into requisition all her resources, if she would keep pace with the times.

There is no room, however, for jealousy here. We all love *all* California. While the northern portion of California may produce some things that we do not, we can produce some she does not.

Where shall we go to find finer qualities of wines, that give forth a more exquisite bouquet, than those from the hillsides of old Sonoma and Napa? You cannot find them, if the proper skill be brought to bear upon their manufacture, even in the vine-clad and sunlit hills of France, and even France has recently awarded us several medals of merit for the wine produced in this State. Let us wait a little while.

But speeches of welcome should be characterized by brevity and heartiness, and, therefore, I must hasten to a close.

A word in reference to raisins. Fresno County has become the raisin center of the State of California—California is now the raisin center of the world. You are not jealous of us, but you will stand in with us, shoulder to shoulder, and try, as we are neighbors, to add to the importance of this most splendid industry.

I congratulate you upon this most auspicious occasion, and I trust that your deliberations will redound not only to your personal gain, but to the advancement of the interests of the State, and I bid you God-speed in the acquisition of the necessary information that may enable you to destroy the pests which in every country attack almost every product. There are enemies throughout all nature to our interests. I trust you may be able to apply the proper remedies, that you may increase the quantity, and along with it improve the quality of our products.

I may remark that it is most propitious that so many men and so many women in this country—men of fine education; men and women who have taken degrees at colleges—engage in these various industries.

Miss Austin, a neighbor of ours—peace to her ashes—who departed this life but a few months ago, came on these deserts and barren plains without any special encouragement, and became the raisin pioneer of this country, and accumulated for herself and her heirs a large fortune. Having done much good in her life, both for herself and her neighbors, she left an honorable name. She was a woman of glorious character, and of most magnificent courage, entitled to one of the highest places prepared for the just and the good. What can not woman do if she will? And so we find intelligent men and women all over the State, who are engaged in these industries. We take pride in them. The young men and the young women of this State have declared the dignity of labor.

In conclusion, let us take an especial pride in the advancement of the interests of the State in which we live, for no State affords such opportunities for enjoyment, promotion, and exaltation in life as California.

Young men, I congratulate you, and young women, too, that your lot has been cast in this land of eternal spring.

By performing your duty in whatever field called, you will find opportunities which, if accepted, will enable you to get upon the tide of success, and with it you may drift to the close of a lofty and useful life. I thank you.

FRUIT PESTS AND THEIR EXTERMINATION.

Essay by Louis W. Burr, Bakersfield.

Gentlemen of the Convention: The subject of "Fruit Pests and their Extermination" is one of special interest to fruit growers just now, in view of the fact that the high prices realized for this season's crop of fruit, both green and dried, will result in a large increase of the area devoted to fruit culture.

We are not troubled with a very great variety of fruit pests in this county (Kern), the codlin moth, woolly aphis, peach moth, red spider, a couple of varieties of borers, and that bane of the California fruit grower, the "pernicious scale," being about the sum of our offenders. Being limited for time, I will confine myself to a few remarks regarding our experience in this county with the latter insect.

The history of the *Aspidiotus perniciosus* in Kern County commences, I presume, like that of almost every other county in the State where it exists, brought here. It was first discovered about twelve years ago in an orchard near Bakersfield on trees sold by a Sacramento nurseryman whose name was by no means "weak" (?). In the course of time, this orchard and its neighbor became so badly infected that fruit would not mature on the trees. About this time a county Horticultural Commission was organized, but, beyond making an abortive attempt at this orchard, accomplished nothing. About four years after the appearance of the pest in the first mentioned orchard, the same insect was found in another orchard ten miles south of the first, and investigation showed that it had been brought on trees purchased from the same Sacramento man who sold the first lot, but at least two years later. On the first tour of inspection made by the present County Board, a third case was found on the "South Fork" of Kern River, in the mountains, seventy-five miles away from either of the orchards mentioned, and inquiry developed the fact that here, too, it came from this same Sacramento man—"bad luck to him!" In this last case, the infected tree had been planted in an isolated place, but *not doing well*, as the proprietor said, it had been moved on higher ground, into the middle of a thrifty young orchard, and had succeeded in infecting the entire orchard. A fourth case was found at Kernville, and again a tree from this same Sacramento nursery was the medium. From these four orchards have spread the insects which have been making life a burden to our fruit growers. Nowhere in the county can a case be found, dating back beyond two years, that cannot be traced directly to some one of these orchards. See the damage caused by one man, and yet he complacently counts his shekels, and would probably repeat the dose should opportunity offer.

The members of the County Board have been greatly hampered in their efforts by the unwise action of the Board of Supervisors. One of these, from some unknown cause, determined to abolish the Commission, and finding that he could not, caused a resolution to be adopted allowing the members of the Commission the munificent sum of one dollar a day, and pay their own expenses. Think of it! less than Chinamen's wages to do such work as was required of us. Well, we just didn't do it, and last spring a new Board of Supervisors set us on our (legal) way rejoicing. In the early part of this year, for the first time, was any concerted attempt made to destroy this pest, and, although late in starting, such success attended our labors that I feel warranted in saying that another season will see an approximate, if not complete, extermination of the pernicious scale in Kern County.

EXTERMINATION.

Perhaps I ought rather to say "prevention," for of what avail is it for a Commission to work faithfully and energetically the entire season, keeping weak and doubting Thomases up to the rack, laboring with the bigoted, and enduring the curses of all, only to find at the end that some measly, grasping nurseryman has nullified all our work and reloaded the county with scale bugs; for a Commissioner, however good his intentions, cannot be everywhere at once; cannot be in the orchard and at the railroad depot at the same time. Last season, when we had completed our work, as we supposed, word was sent us that a new lot of nursery stock was being delivered from Sumner. An immediate inspection showed the stock to be badly infected with the pernicious scale, and this stock, too, came from Sacramento—oh! Sacramento—and a good part of it had already been delivered to different parts of the county, despite our published warning to the public not to receive nursery stock from outside the county without either a clean bill of health or a certificate of disinfection accompanying each shipment. It seems to be the hardest thing in the world to convince people that you are working for their best interests. They get an idea into their heads that you are trying, in some mysterious way, to get the best of them, and that settles it. You can't do anything with them until you convince them that you have power to compel them to do what you are trying to persuade them they ought to do of their own accord. Now, in the matter of the nurserymen, it certainly seems to me that under the law the State Board of Horticulture has full power to act. It is only necessary for them to make and publish a regulation requiring each and every shipment of nursery stock to be accompanied either by a clean bill of health or a certificate of disinfection from a County Commissioner, a local Inspector, or a Quarantine Guardian; such bill or certificate to be not more than two months old either, and then we have some chance of holding Mr. Nurseryman down; and the Board can't make such regulations too strict, and a nurseryman should be promptly and publicly quarantined every time he is caught attempting to evade it. The press could help us, too, by publishing notice of such action on the part of the State Board, which would tend to make a man very cautious about running up against such publicity. Certainly, no one should hesitate in being severe with such a man; *he* never hesitates in inflicting untold injury on the fruit-growing portion of the community.

The extirpation of the insect itself, so far as the killing of it is concerned, seems to me to be the simplest part of the problem. When our present Commission first began operations, we recommended the caustic soda and potash remedy. I have seen some excellent work done with this wash, but such cases were the exception, rather than the rule. It seems to depend entirely upon the manner in which the wash is compounded and the way it is applied, and the same rule will equally apply in cases of all washes. Our friend, Mr. Cadwell, of Petaluma, very aptly expressed the true inwardness of this when he said: "Now, in putting this wash on, I do not go to town and say to my Chinaman, go and put this on. I do not say to my hired man, do it before I come back. I go myself and prepare it. I get my men, and go right with them, and I put it where it should be, and there lies the success of all your washes." We use the winter remedy recommended by the State Board in their regulations, bearing date of June 29, 1889, being:

Lime	25 pounds.
Sulphur	20 pounds.
Salt	15 pounds.

Care must be taken, however, to keep constantly stirring while boiling, otherwise your compound will crystallize and have no strength. This remedy is absolutely murderous in its effect. No scale bug can hope to escape if once within its embrace, and "there's the rub." There is where Mr. Cadwell's remarks fit in. To hit the scale bug is the true secret, and only careful, painstaking work will do any good. At first, when using this new remedy, it seemed as if we had made a failure. At several places where the solution had been used but once, a second inspection showed that the insect was apparently well, and thriving under its coat of whitewash. In such cases a second spraying was ordered, which left nothing but a mass of scurf to tell where the bugs had been. In one case, however, the second application had not been made, and being near my own place, I kept close watch upon it. Examination with a hand glass failed to disclose any live insect on the surface of the tree. Turn up the outside coating of wash and scales and bugs were visible in plenty, and the microscope showed them to be alive. For at least six months this state of affairs continued, and yet, in all that time, not a single scale bug could be found on the new growth of that tree, although it was twined in and laced about the older growth; nor did the fruit show the presence of the insect; but the tree then began to wither, until finally the older portion died, leaving the newer growth from the bottom vigorous and clean. A second application would undoubtedly have killed the insect and saved the (peach) tree.

I certainly think this remedy is the solution (?) of the problem: "What shall we do with our (San José) scale bug?" only its intelligent preparation and application is a prime necessity. Don't leave such work to a careless or stupid laborer, whose only object is to get through a disagreeable job as soon as possible, but give it your personal attention. You may not be able to get all the insects the first year, or even the second. Suppose you *do* have to make a third attempt; won't your orchard pay for it? And, having cleaned your trees, if you do not watch those outside parties, and help your Commissioners and Quarantine Guardians to keep you from getting loaded up again, you may depend upon it your orchard will not pay you.

DISCUSSION.

Mr. N. W. Motheral: I will state to the Convention that in traveling over the State I find the same state of things that this gentleman reports. I have traced the San José scale to nursery stock that was infested and shipped into these counties from other sections; their own nursery stock was nearly always free from the San José scale. I find that where they have properly applied this wash—the salt, sulphur, and lime—they were uniformly successful in killing the scale. I found some cases where it was a failure, but on making an investigation, which I always did, I found that they had not boiled the sulphur and the lime in the first mixture; that they had just mixed it, and there was no chemical union formed. I am satisfied that this is the remedy for the San José scale, and if the instructions of the Board are followed, that we will succed at least in keeping the San José scale in check everywhere. I find in parts of the State, orchardists who were using the wash made of resin and caustic soda about a month before the fruit is marketed, now using just a light spray over the trees, and that this would kill the insect, and the color would be restored to the fruit, and they marketed it without any damage. This I find being done by several parties, and if well done, I think it will be a remedy. This remedy, properly applied, will always relieve you of speckled fruit, and give you good fruit to send to market. There is no excuse for any nurserymen sending out infected trees, for it is the easiest thing in world to disinfect with this lime preparation.

Mr. Frank A. Kimball, of National City: I will ask at what time the resin and caustic soda wash should be applied on the fruit. I understand the gentleman to say that several parties had tried it.

Mr. Motheral: I didn't have time to experiment with it myself, but I am satisfied it will do. I could not give the exact time, but from what they told me it was about a month before ripening. They took two and one half pounds of caustic soda to ten pounds of resin, boiling them together until the resin is thoroughly dissolved, and then adding enough water to make one hundred gallons. Spray this on, and it puts a varnish over the fruit and over the insect and kills him, and the color will be retained. It has to be done in time for the entire retaining of color.

Mr. Stabler: I will ask Mr. Thomas, of Visalia, if he uses the same formula which he recommended last year?

Mr. Thomas: I would answer the gentleman that I would use just the same as the published recipe: Take ten pounds of lime, and start with twenty gallons of water and twenty pounds of sulphur; boil it three quarters of an hour, and that dissolves the sulphur with the other material; then slack your other ingredients with an outside bath, and that will make sixty gallons. In applying it to the orchards I would recommend that on plum trees and apple trees, they having a smooth bark, two applications be made in the winter time, for they don't seem to hold the wash like the peach or the nectarine, which have rough barks. I do not claim to be the author of this, and I would like Mr. Motheral to state who is, and let the gentleman have the credit before he dies, so that the fruit growers can give him a marble slab.

Mr. Motheral: I think, Mr. President, that Mr. Thomas deserves as much credit, perhaps, as the author, for he has been pressing this subject upon the attention of the fruit growers of the State for a long time, and because it was a sheepherder's dip, nobody would believe there was any merit in it until he demonstrated it. The facts in relation to it are these: Mr. Habler, a large sheep man of Fresno, every spring dipped his sheep for the scab, and had a neighbor, who had a little orchard that was being destroyed by the scale. He asked him, "Why don't you take my sheep dip that is left over, and try it on your trees?" Says Habler, "I will tell you"—he was a little bit profane and he says, "It will kill the devil." I suppose he had never tried it on him, but still it was a theory of his, and he, finally, by dint of very strong language, got his neighbor to try it, and to the utter astonishment of the latter it not only killed the scale, but it invigorated the trees so much that the next year he had a fine crop of fruit and a fine orchard, whereas before he had looked upon his orchard as gone. This man is named Habler. He is living in this county now, or possibly in Tulare, but he has property here.

NATURE'S METHODS FOR SUBDUING INSECT PESTS.

Essay by D W. Coquillett, Los Angeles.

Mr. President, Ladies and Gentlemen: Every student of Nature is aware of the fact that in accordance with certain well established laws, the various kinds of plants and animals, of birds and insects, are restrained from becoming unduly multiplied so as to threaten the extinction of the species of plant or animal on which they feed; and whenever any species does thus become unusually abundant, this of itself is conclusive evidence that one or more of these natural laws have been interfered with—a condition of affairs that is usually brought about through the agency of man. Take, for instance, the rabbit pest of Australia. In their native land in England these animals never become sufficiently numerous to be regarded as pests; the inclement weather—the long winter rains—and the persistent attacks of their natural enemies—the hawks and owls, the weasels and other predatory animals and birds—prevent them from becoming unduly multiplied. In other words, in their native land the conditions are perfectly natural, and in consequence of this these animals never become unduly plentiful.

But when a colony of them were transported to Australia and liberated, the conditions, through the agency of man, became entirely changed; they found in their new quarters a climate admirably adapted to their rapid increase, their natural enemies had been left behind, and as a natural consequence they were enabled to multiply to such an alarming extent that man, with all of his devices for their destruction, was unable to cope with them.

In our own land we have a somewhat parallel case in the history of the Colorado potato beetle (*Doryphora 10-lineata*, Say). During the year 1819 or 1820, a party of explorers found specimens of this insect on some plants near the base of the Rocky Mountains, where it had evidently existed from time immemorial. On the one hand were the mountains, which formed a natural barrier to its spreading in that direction; on the other hand was a vast stretch of country where no plants grew congenial to its taste, so that those adventurous individuals which, prompted by an inborn instinct to "spread abroad and multiply," flew out in either direction, must necessarily have perished of starvation before arriving at a place where their favorite food-plants grew. Those less adventurous, who were contented to "stay at home," suffered still further decimation of their numbers through the inclement weather as well as through the attacks of their natural enemies; so that their numbers were always kept within due limits.

But all this was changed when civilization, in its westward march, had reached a point not far distant from the native home of this insect, and fields of potatoes were planted at various places on the plains. The insects, finding the leaves of the plants agreeable to their taste, rapidly spread from one field to another; and thus, by getting away from their old-time enemies, and finding an abundance of food always within easy reach, it is not at all surprising that in a comparatively short space of time they had so multiplied and spread abroad as to threaten the entire destruction of the potato crop in several of the States.

Now, if the early discoverers of these insects had taken a colony of them and turned them loose in the midst of some of the largest potato-growing sections of the East, we would have had an example of what has unintentionally been done in our own State in relation to the introduction of our most injurious kinds of insects. As is well known, but a comparatively small number of species of our native insects are destructive to cultivated plants and trees, those which occasioned such widespread destruction being natives of other lands, having been imported here either through ignorance of their habits, or through criminal carelessness. This being the case, it is evident that if we wish to reduce their numbers to a normal status, it would be necessary for us to bring about the same conditions that exist in their native land.

Among the more potent factors that tend towards preventing the too rapid increase of insects may be mentioned inclement weather, especially long-continued rains, and the attacks of insectivorous animals, birds, and insects. That long-continued rains are inimical to the increase of insect pests is well illustrated upon this coast in the northern parts, where insect pests are almost unknown; whereas in the southern portion, where the rainfall is very scant, insect pests are so extremely abundant as to lead one observer to remark that the only production of this part of the State that didn't have scale bugs on it is the climate!

It would, of course, be futile to attempt to bring about a greater precipitation of moisture in a land where the conditions are so much against it. Moreover, so many of us left our homes in the East in order to escape the long-continued rain storms and snow storms, the cyclones, and other climatic freaks, that very few would desire to have our climate other than it is. For these reasons it will be necessary for us to turn our attention to the other agencies referred to above.

That any kind of animal, bird, or insect that is able to thrive in any other land would thrive extremely well if imported into this State, goes without saying; so there is every reason for believing that almost any kind of animal, bird, or insect found to attack insect pests in other lands could be successfully introduced and propagated in the orchards and orange groves of our own favored State. As an instance of what may be accomplished in this direction, I may mention the case of the Australian ladybird (*Vedalia cardinalis*, Mulsant), recently introduced * * *. The rapid and thorough manner in which this insect has swept the destructive Icerya from our orange groves is simply astonishing. As I have given an extended account of this ladybird in "Insect Life" for September of the present year (1889), it will be needless to repeat it here; but a few additional facts may be of interest.

From the one hundred and twenty-nine specimens received between the thirtieth of November, 1888, and the twenty-fourth of January, 1889, and colonized on an orange tree under a tent in the City of Los Angeles, by midsummer I had, with the aid of Mr. J. W. Wolfskill and Mr. Alexander Craw, distributed nearly fifteen thousand of these ladybirds to different localities throughout the State. This will give some idea of the rapid manner in which these insects increase.

My first attempt at colonizing these ladybirds on trees in the open air was made in the thirty-five-acre orange grove belonging to Colonel J. R. Dobbins, of San Gabriel, in Los Angeles County. This was on the twenty-second of February, 1889, and the colony consisted of thirty-five individuals. I placed a second colony in the same grove on the twentieth of the following month, the latter colony consisting of a little over one hundred individuals. The grove was very thickly infested with Icerya at the time of colonizing these ladybirds in it, and what the latter have accomplished may be gleaned from the following letter received from Colonel Dobbins, under date of October 22, 1889:

> **Dear Sir:** Your favor of the twenty-first instant is at hand. The Vedalia had practically freed my orchard from Iceryas on the thirty-first of July. It was on that date that I was obliged to post a notice at the entrance to my place saying that I had no more Vedalias for distribution. The scale and ladybird had fought out the battle, and while the carcasses of the vanquished were everywhere present to tell of the slaughter, the victors had disappeared almost entirely from the field. I have thirty-five acres in orchard, some thirty-two hundred trees in all. I never colonized any Vedalias in my grove excepting the two consignments which you brought to me yourself—one box on February twenty-second, and two boxes March twentieth. I noticed the first increase from the Lot No. 1 on the fifteenth of April, and from Lot No. 2 on the twenty-fourth of same month. On the twenty-fifth of April I found larvæ upon several adjacent trees. These facts are from memoranda made at the time. I have a list of the names of fruit growers—two hundred and twenty-six (226) in number—to whom I personally distributed over one hundred and twenty thousand (120,000) Vedalias, in colonies of various sizes, between May thirty-first and July thirty-first.

The following interesting account of the working of these ladybirds in the large Chapman orange and lemon groves in the San Gabriel Valley, covering one hundred and fifty-five acres of land, is from a letter received from one of the owners, Mr. A. Scott Chapman, under date of October 18, 1889:

> **Dear Sir:** The Vedalias that you brought to my place about the twentieth of last March, and which we colonized on four large orange trees that were covered with fluted scales, have spread in all directions, although, to begin with, they followed the direction of the wind most readily. From those four trees they have multiplied so rapidly that in my orchard of three thousand trees it is seldom that we can now find a fluted scale. I find a few of them on some weeds in spots, but I can also find the beetles there. The trees have put on a new growth and look altogether different, even the black fungus on the old leaves has loosened its hold, and begins to fall to the ground. Besides having cleared my orchard they spread also to the orchard of my cousin, and to my father's orchard. The latter was also reinforced by colonies from Mr. J. W. Wolfskill and from Colonel J. R. Dobbins. As my father has some ten thousand trees, and almost all were more or less infested, the Vedalias had a grand feast ahead of them, and they have done their work wonderfully. What I have said of my orchard applies to father's also, and really to all of our neighbors. When the Vedalias first began to multiply, we took colonies of fifty or more in the pupa state, and placed them in different portions of the orchard, and even had we not done so, the Vedalia, unaided, would itself have reached there in almost the same time.
>
> On the Chapman place, the Vedalias have cleaned the fluted scales from one hundred and fifty acres of land. They have taken more than an oppressive burden off the orange growers' hands, * * *.
>
> Respectfully yours,
>
> A. SCOTT CHAPMAN.

The obtaining of such beneficial and highly satisfactory results through the importation of only one of the natural enemies of our insect pests, indicates what would undoubtedly follow if all of the natural enemies of these pests could also be introduced into our infested orchards and orange groves.

DISCUSSION.

In reply to questions, Mr. Coquillett said that there is no probability that the Vedalia will ever destroy all of the cottony cushion scale on this coast; that is quite out of the question; but it will keep them within due limits, and in order to distribute them it will be necessary to establish propagating stations, from which they may be sent to any region where the Icerya should happen to break out.

Mr. D. W. Thissell, of Winters: Seven years ago I conceived the idea of entrapping the codlin moth, and during that period I have invented three different styles of trap; during the last three years I have succeeded beyond my most sanguine expectations. The working of the trap is simply this: The tree is cleaned of its hiding places, the trap is placed upon the trunk, and every larva that crawls up or goes down the tree enters the trap and goes through its transformation and comes out a full-grown codlin moth miller, which cannot escape, but remains in the trap three days and dies. The expense upon a six-year old tree is four cents for the first year, and the trap will last from three to five years; I have had them upon my trees now three years, and they are just as good as they were the day they were placed. Putting that estimate upon it, allowing that the trap will last only five years, it will cost a little less than one cent a year to protect your trees from the ravages of the codlin moth, not including the cleaning of the tree.

Mr. A. T. Hatch, of Suisun: I would like to say in that connection that I have used something similar to this—not quite the same—with very good success. However, I found it necessary to spray my pear trees in the spring on account of the saw-fly worm which attacks the foliage, and when it blossoms eats the leaves, and the sap not coming freely the young fruit falls off. We use a spray of Paris green or London purple, one pound to two hundred gallons of water, and that destroys all these saw-fly worms. We find that some of the Paris green lodges in the blossom end of the fruit, where the codlin moth first lays its eggs, and when the young are hatched out they proceed to work, and the first thing they get is Paris green; we also find that the leaves and branches are the parts first attacked by the slugs (they only attack the perfected leaf), and the spray having touched all those leaves, when the eggs deposited upon them are hatched, the first food of the young slugs is Paris green. For the codlin moth, in addition to this first spraying we put on an additional spraying before the fruit turns down; after the fruit turns down it is almost useless to use this or any other spray for the codlin moth. In our part of the county we have found that to be the very best remedy we have used. Two hundred gallons of the mixture cost from 20 to 25 cents, and since we have begun using it we have no fear of the codlin moth on our pear or apple trees.

Mr. Motheral: I can say that I found parties all over the State using this wash on apple trees and as effectually as on pear trees, saving from 75 to 90 per cent; and those in the same locality who did not spray with Paris green lost all their fruit. It is necessary on the apple to spray twice, before the apples turn down, and then later on. The last crop of the codlin moth that destroys the winter fruit will lay its egg anywhere on the side of the apple, and if an apple touches another one it will lay between the two. In the first crop, I believe, the eggs are layed in the blossom end; later on, anywhere.

Mr. W. H. Aiken, of Santa Cruz: As to the length of time that the Paris green will remain upon the fruit, I believe that upon the coast, where the atmosphere is charged with moisture and occasional fogs, it is almost impossible to destroy the codlin moth by this wash; that is, in Santa Cruz County and in portions of Santa Clara County. I know one year I washed five times with Paris green—a pound to one hundred and sixty gallons—and myself and neighbors lost two thirds of our apple crop in spite of all. We began before the apples turned down, with a strong preparation, indeed, so strong, that in many cases it destroyed the leaves; but the codlin moth fattened and grew all the same. The codlin moth seemed to work in September on the Newtown Pippin apple; there may be somebody here from San José better informed as to that exact locality, but I cannot say that the wash has been entirely successful there. I know in Santa Cruz that it has not, and in the apple-growing regions of Santa Cruz it is not very much practiced at present. I believe in the warm valleys where the codlin moth appears very early, and they are not very numerous, there may be very good effect. One neighbor of mine who sprayed quite extensively, and had a large apple orchard, tried bands, not exactly like these exhibited here, and he washed and sprayed his trees. He caught a great many in the bands, and he said, when lying down under his trees one day, he happened to turn over some lumps of dirt, and he found a worm under almost every lump of dirt, and he said he didn't see the use of working on the bands when the ground itself was alive with the codlin moth. It is the enemy of the apple particularly, not so much the pear. I known of pear orchards that have almost entirely escaped the ravages of the codlin moth, while the apple seems to be its natural nourishment and is very much preferred. I sometimes think when there are no apples, they go into the plums and prunes. I am not certain; I have found what appeared to be something like that. Whether we can, as a State at large, entirely escape the ravages of the codlin moth, I very much doubt. There are inventions to be tried, and work to be done, and we shall be able, as we are able in the case of the San José scale, to reduce the number and relieve the trees from that loss of vigor caused by the excess of the San José scale. Of course, a tree will stand a great many of the San José scale and bear a very fair crop of fruit, notwithstanding its struggle for life. In all these washes there may be something found that will entirely eradicate it, but I have yet to see it; although by the use of some of them we can save our orchards so that they make a profitable crop. The ravages of the codlin moth are very extensive. It has made havoc in Oregon, Salt Lake City, and other parts of the coast, and, I believe, will spread all over the coast. I hope my friend, Mr. Thissell, will get this band to work successfully. I have used it myself at his request, and quite successfully, although not so as to effect anything permanent. I am very much pleased with it, and I have no doubt it will kill all the codlin moths that either go up or down the tree; but is Mr. Thissell certain that it has any effect on moths under lumps of dirt, or in ordinary fences and many other places?

Mr. Motheral: I know that the objection has been made to this wash that it is poisonous, but I have never known anybody to be poisoned with it. Evidently there is some danger if it is carried too far, so that this Paris green remains on the fruit. It does not seem to me that it would be wholesome. I don't think there is any danger in using this wash in the spring, but later on in the season I don't know how it would operate. I have never heard of any one being poisoned by it, yet I have found parties that were afraid to use it.

Mr. Frank A. Kimball: In regard to the codlin moth hibernating, pupating in the ground; I have taken occasion to examine trees that were growing on adobe soil that was more or less lumpy. Two years ago I examined trees in the orchard of Mr. Walker in Paradise Valley, in San Diego County. He had his trees well bandaged with burlaps in the ordinary way; under the bands we found at one time seven worms; in the ground, and within four feet of the tree, we found forty-three hibernating under the clods.

Mr. W. H. Aiken: In putting on this Paris green, in some portions of the State they use resin so as to make it stick, and spray the trees right up to August and September. The chances are they get a pretty good dose on an apple. I am a little skeptical in this matter. I don't use the resin, and I don't like to do it, but I understand it has been used for that purpose.

Mr. Lelong: I want to suggest that Mr. Coquillett be invited to tell us something about the beneficial effects of parasites on the red scale in San Gabriel and Los Angeles. A new parasite has been discovered there.

Mr. Coquillett: In regard to the parasite on the red scale, I have examined the subject quite thoroughly, and there are places where the parasite, to all appearances, has rid the trees of the red orange scale. There is one quite extensive orchard that a year ago was very badly infested with the red scale, and the owner informed me that he had done nothing to cure it whatever, except to spray with pure water—the washes had very little effect, except when the scales were first hatched; and many of them are infected with the parasite, so that a majority of the scales have been destroyed by it. There are two kinds of red scale that have affected oranges and trees; the variety in San Gabriel Valley is supposed to have been imported from Japan, and the parasite attacks that variety alone; at least, we have never found it destroying the other variety. As to whether this little parasite will ever prove effectual, in the way of ridding the trees of the red scale, remains to be seen. I halfway doubt it, for its progress is not as rapid as that of the Australian ladybug has been. I am not aware that this belongs to any of the genus in the United States, so it may have been introduced on the red scale from Japan, or any other country that it has been brought from, but whether it will prey on the other variety of red scale or not remains to be seen. I have had specimens of it sent to the Santa Ana Valley, and it is yet too early to foretell whether it will feed on that scale or not. As long ago as 1880, Professor Comstock found parasites on the San José scale; I think in the vicinity of San José itself, and he treated on it in his report for 1880. We have the same variety in Los Angeles, and I know at least one orchard that has been very nearly rid of the San José scale, through the working of the parasite, but now again the scale is becoming almost as bad in that orchard as it was at first. It is well known that the black scale cannot thrive in very hot localities, but that is not the case with the red scale or the San José scale or with the cottony cushion scale. With the latter the hotter and drier the locality, the more rapidly it seems to multiply and spread. In relation to the black scale, I have known it to be killed out in very hot localities during the hot part of the year.

Mr. Hobart: I would like to say I live in a district where they have had oranges and lemons growing for seventeen years, and never saw a scale of any kind, black, red, or any other; it is very hot, and the rainfall is for the last year about thirty inches; the very hottest was 105 degrees, sometimes 108 degrees—that is in the Ojai Valley. I have never seen an insect of any kind other than the red spider on almond trees, and I treated them as suggested and killed two or three. The next year we had sixty-five inches of rain, that is, seven years ago, and I have never seen the red spider since, or any other injurious insect.

Mr. Morrison: I will say that in the foothills of Placer County, where we have a few orchards, there are orange trees thirty years old, on which there have never been scale. In the orchard of J. W. Smith, of Horseshoe, there is a thirty-year old tree which has never had a scale of any kind, and Mr. J. W. Wilkes, of Newcastle, also has trees thirty years old that never have had scale. We know nothing about the scale on orange trees in those foothills. I planted out orange trees covered with the black scale that I didn't notice; I wasn't an horticulturist in any sense of the word, and when I found them I thought my orchard was ruined, but the next visit I paid to the orchard they were all gone; where they went I don't know.

Mr. Lelong: Statements have been made that trees infested with the red scale have been taken into Oroville and the scale had seemingly disappeared afterwards without any apparent cause; and this was attributed to climatic influence. This I think is a mistake, because during the last two years there have been a great many specimens sent from that locality which the writers have claimed was the red scale, but in no instance has there ever been received a specimen of the red scale from those districts; in most cases it has been the brown or soft orange scale; the color of it resembles the black scale. The red scale lives in the hottest country on the globe; it destroyed many orange groves on the Cape of Good Hope, where the thermometer in the summer goes up as high as 125 degrees; where the trees in the summer have been scorched until nearly ruined for a time, but the heat did not kill the red scale. No specimens of the red scale have ever been received at the office from that part of the State.

Mr. Motheral: At Marysville I was told that twelve or fifteen years ago the scale was carried there and it took ten or twelve years to spread over that little town; there must be some condition, climatic or otherwise, that has not been favorable for their multiplication.

Mr. Kimball: It is clear that the red scale does not spread rapidly. It has been at Riverside for a good many years, and last season the citizens decided to take heroic measures for its extermination; and they bought some three or four blocks of land nearly in the center of the town of Riverside, and cut the limbs entirely back, making the trees hitching posts. I think they paid $5,000 for the privilege of cutting off the tops of the trees, and they thereby probably entirely exterminated the red scale from Riverside.

Mr. Lelong: I hope it will not be inferred that the scale that exists in Marysville is all over everything. Marysville has but very few orange trees, which are generally in gardens and front yards. There is one small orchard near the river. A great many reports are made that the scale is all through there, but I do not suppose there are five hundred orange trees in Marysville or vicinity, and it is confined to that locality.

Mr. Pyle: They say every man is happy when he has a hobby to ride, and no man is happy without a hobby. Now I cannot let go of the raisin proposition. We have among us very eminent raisin men who have made a business of that matter, whose property is threatened, and they ought to be making investigations, or to have made investigations and experiments, and be able to tell us something about this vine disease. Now, this is a matter that should not be hidden, and I think it is the duty of any man in Fresno County, if he has lost a vine from that cause, to let this Convention know it.

FIG CULTURE AND SEEDLING SMYRNA FIGS.

Essay by E. W. Maslin, Loomis.

A *fact* is a serious thing, and the most difficult matter in this world to determine. And this truth all horticulturists appreciate who have ever endeavored to ascertain the origin and characteristics of any new varieties of fruit. We are deeply interested in knowing, for a certainty, whence came and how originated an approved variety of fruit; first, that the first grower may have the credit of his experiment so that others may be incited by his example, and secondly, that others may repeat the experiment, under, possibly, better conditions. I once wondered why there should be so much doubt as to who originated the Muir, Thissell, or McDevitt peach, or who imported the Zinfandel, Tokay, and other varieties of grapes. I no longer wonder since my experience in searching for the Smyrna fig or fig of commerce. For six years I have pursued it in nearly every county, but have not yet found it. Nearly every nurseryman's catalogue tells you that he has the true Smyrna fig, and at each county fair there is an exhibitor who has the Smyrna fig, which, in the stereotype language of the committee on prizes, "is superior to the Smyrna imported fig, and must displace it in the markets of the world." I have found but one grower who has not confessed to me that the so called Smyrna fig was not a Smyrna fig, but was only so called because it was *white*—nurserymen never confess.

The truth is that there is not at this day in the State a fig which we can say positively and with absolute certainty is the same fig as the Smyrna fig of commerce, or if any one has produced a Smyrna seedling that it is equal to the imported fig. It seems to me the veriest nonsense to declare, as is declared each year, that certain dried figs are superior, or even equal, to the Smyrna fig. The Smyrna fig has established its character, and is accepted in all the markets of the world as the highest type of dried fig. It is the standard fig of commerce, and it is useless to try to supplant it by any fig not at least its equal.

The edible fig, as we find it, is a collection of small fruits surrounded by a fleshy tissue abounding in sugary juice. The thinness of the skin of the receptacle, the amount of saccharine matter and fleshy tissue, and the number of seeds, determine the quality of the fig. The excellence of the Smyrna fig lies, as Mr. Gustav Eisen has so well and often pointed out, in the abundance, in the receptacle, of the minute fruits or so called seeds, and especially in that these seeds are filled with albuminous matter of a strong aromatic flavor. No one mistakes the taste of a Smyrna fig, and this taste, so acceptable to all, is derived solely from the seed. Until, therefore, we can produce a fig containing fruits or seeds filled with like albuminous matter, we cannot hope to equal the Smyrna fig. I believe it possible to produce such a fig, though Mr. Eisen doubts it. He suggests the theory, for many centuries accepted in Asia, that the edible or carica fig contains no male flowers, and that the female flowers are fertilized by an insect proceeding from the capri or wild fig, bringing the pollen of the male from the latter fig and depositing it upon the pistils of the female flower in the former; that such pollenization hastens the maturity of the edible fig, enlarges it, and causes the formation of the albuminous matter. If this theory is correct there is no room for experiment. It is true, as he says, there are no figs in California which contain fertile seeds. Incited by his example, I have examined hundreds of figs, and failed to find the germ. A trained microscopist in Sacramento has for several years been trying to find the male flower, but without success. But this proves nothing. It does not prove that the Smyrna seed will not produce a Smyrna fig. Some of the most learned botanists of Europe have given profound study to the character and origin of the edible fig of Smyrna, and they are not agreed. Entomologists are even discussing as to which order or class the fig insects belong. But while so much learning is expended upon theory, I have yet to read of any savant following the only true and Yankee way to determine the truth, *i. e.*, plant the seed and wait for the result, while I do read that in Aiden the fig is produced by seeds, layers, and cuttings.

Gasparini, as early as 1840, made experiments in the caprification of the fig in Italy. His experiments covered a period of about five years, and his conclusion was that the intrusion of the insect was a damage to the fruit; that the capri, or wild fig, and the carica, or edible fig, are distinct genera, and, therefore, the capri fig is incapable of fertilizing the edible fig.

Graf Solms Laubach regards the edible fig as of one race and the capri as of another race, of one and the same species—the former having developed from the other under conditions of cultivation.

Franz Muller says he agrees with Linnaeus that they represent different forms, the male and female, not proceeding one from the other, but developed side by side by natural selection. He cites in support of his position that the seedling offspring of the fig, fertilized by the capri fig, consists of varieties of the edible and capri fig, pure and simple, without any forms intermediate between the two parents.

Once a king propounded to his learned men this question: Why is it that a fish put into a bucket of water of known weight will not increase the weight of the whole? Whereupon the literati began to discuss the question. It was assumed, of course, that the weight would not be increased. The point was to present a theory which would account for the assumed fact. The discussion waxed hot, factions were formed, and the kingdom was in danger of being rent in twain. Finally a poor fellow of Yankee mind suggested that a fish be put in a bucket of water and weighed, to determine the fact before further discussion. It was done, and discussion ceased, but it is recorded that scientific men of that era lamented that the experiment had removed from scholastic philosophy a very interesting question.

After I had read, so far as I could, the discussion upon caprification, I put the fish in a bucket of water and weighed the whole. In other words, I did what should have been done before, I planted the seed of the Smyrna fig *and raised a Smyrna fig.*

In the spring of 1885 I bought in San Francisco a box of the largest Smyrna figs which I could find, and sowed the seeds in a hot bed, letting the growth remain until 1886, when the trees were planted on a hillside in deep, warm granitic soil. They have made a wonderful growth, the trunks being from four to six inches in diameter, and the trees ranging from ten to fifteen feet high. They have never been irrigated, but have been cultivated. They have borne this year an abundance of fruit, which, while it remains on the trees, has not matured. The figs are about the size of a pigeon's egg, the receptacle well filled with flowers, but so far I have not observed any seed. My impression is that the forces of the trees have been expanded in making wood instead of fruit.

Determined to have the best fig in the country, I wrote, in January, 1886, to H. K. Thurber, of New York, one of the leading importing merchants in the United States, requesting him to obtain for me a box of the very best Smyrna figs, telling him my purpose. He replied as follows:

> New York, February 1, 1886.
>
> The best grades of Smyrna figs are sometimes described as "Eleme," "Imperial," "Choice Layers," or "London Layers." I have ordered sent to you a box of "Imperial," which are the best in the market. There is no charge for them. I should be only too glad if in your wonderful soil and climate you should successfully raise a fig equal to the Smyrna fig.
>
> Very respectfully yours,
>
> H. K. THURBER.

The seed of these figs I sowed in a hothouse. Fully a month elapsed before there was a sign of growth. Later in the spring of 1886, the young trees were transplanted to the nursery, and planted in rows two feet apart, and eight inches apart in the rows, and immediately covered with straw to shield them from the sun. They received no irrigation. In the spring of 1887 they were set out in the orchard twenty-five feet apart hexagonal or triangular form. They were allowed to grow as many branches and trunks as came, for the purpose of inducing extensive root growth. In the spring of 1888 they were cut down close to the ground, and of the sprouts which came, one, the strongest, was selected and the others removed. As the stem or trunk grew, the lateral branches were pinched back, but not removed; pinched only that the stocky growth might shade the trunk, and not allowed to grow that the forces of the sap might be concentrated to making a leading shoot and a stocky trunk. The fibrous roots at the surface were removed to force the tree to depend on the lower system of roots. I am not offering this culture as the best. I have not observed sufficiently to form a firm opinion which is the best mode of preliminary culture. The only pruning I have done is to sucker them and cut out the crossing wood. These trees bore fruit this year upon the wood growth of 1889. I have about ten acres planted altogether—seven acres of the sowing of 1886, and three acres of the first sowing. The fruit did not drop but remained on the trees until the late storm. A few days after the storm began I found on four of the trees about a dozen perfectly ripe figs. They were about the size of a pigeon's egg, cuneate or wedge shape, but rather flatter than the White Adriatic, with a short stem. Their color was a lively yellow, the flesh amber, but containing only a few seeds, which were very small. The taste was deliciously sweet. The other and immatured fruit was well packed with fleshy tissue, and except that it was green, did not differ in appearance or shape from the ripe fig.

One fact to which I wish to call attention, and a very important one, in relation to the necessity of caprification, is that the leaves of all the fig trees grown from seed obtained from Mr. Thurber are identical in type. There is not the slightest indication of the cross fertilization by the wild fig, such as a wild or scraggling growth or difference in the color of the bark. The growth of the tree is very upright and the color of the wood is the same. The small size of the ripe fruit, I ascribe to the lateness of maturing and the youth of the tree. I have brought with me some of the leaves of the trees which bore the ripe figs, to which I invite your attention.

In respect to proper pruning I have nothing that I can offer with certainty. In my reading I find that in the valleys of the Meander and Aiden, whence come our best imported Smyrnas, the trees are forked at six feet from the ground, it being claimed that this is necessary to produce the best fig. I have forked my trees at all distances under four feet, so I shall be able in a few years to determine the question. There is one point upon which I seek information and I shall be grateful if some one who knows it to be a *fact* will state whether it be true, as has been stated by some writers, that pruning the branches annually has a tendency to diminish the size of the fruit and the ability of the tree to bear fruit.

It must be remembered that the White Adriatic bears its fruit upon the wood of the current year, and I think such will be the habit of the Smyrna fig. If such is the case, and the old wood is not to be pruned away, the trees will grow out of control. On my seedling, the growth of branches has been six to ten feet, and I notice that the larger wood buds for next year's growth are out toward the end of the limbs. If the limbs are not to be reduced it seems to me that in time the tree will become too top-heavy, and the fruit too high for economic picking.

It is yet to be determined which is the best section of the State for the culture of the fig. In the valleys, no doubt, the tree growth excels that in the foothills, and possibly the fruit will be larger, but taking the White Adriatic as an example, I should say that the fruit of the foothills, at least of Placer County, has a tenderer skin, the flesh is lighter in color, is more transparent when dried, and contains more saccharrine matter than that of the valleys. Dr. Stillman, who visited the Smyrna district, informed me that the climate and topography of the foothills of the Sierra Nevada were identical with that of Smyrna.

As to the best variety of plant, I suppose it is conceded that the White Adriatic is the best. But for those who desire to experiment further it may be interesting to know that the Brown Turkey, well sulphured, cures as beautifully as the White Adriatic. Dr. Stillman, in 1887, informed me that of the importation made by him in conjunction with the "Bulletin" Company, but one tree bore an edible fig; that the others were wild trees. In 1888, he sent me three small trees of the variety, which bore this year. The variety, I was informed, was the Brown Turkey. I have some of the leaves with me, and would like to have the variety identified. The fruit was dried this year by Mr. James Curry, of Loomis. It was sulphured about an hour, and the result was a fig fully equal, in all respects, to the best White Adriatic of Placer, except there was slightly less fleshy tissue.

I hope I may be pardoned for alluding to a subject not strictly cognate to that of this essay. We are on the threshhold of entering upon a great industry. Fig culture, I confidently believe, will, in five years, rank in importance with that of the raisin, prune, or grape. Now is the time, before it is too late, to establish the nomenclature of the varieties of figs that will be grown and offered to the public. I confess I see the difficulty, but if this Convention, or the State Board of Horticulture, assumes the authority to name varieties, their action will be respected, just as, by an unwritten law, the right to name a plant by the discoverer is respected by the scientific world. We are already in confusion in respect to the names of certain varieties of figs. Mr. Milco, now deceased, informed me that he imported the White Dalmatia, which, by some one, was named the Enrich, and that name was afterwards changed by a nurseryman to the White Pacific. On the other hand Mr. Milco put on the market an alleged importation from Dalmatia, which he called the White Adriatic, which a veteran fig tree importer of undoubted integrity told me had been imported by him over twenty years ago, under the name of *Verdoni*.

An instance right at hand of the confusion incident to naming varieties without the investigation of a body of men charged with the duty of determining names and varieties of fruits, is presented in the naming of the fig grown by Mr. Parker, of Placer. Mr. Parker claims that the fig is a product of a tree imported as a genuine Smyrna by the "Bulletin" Company. If such be the case, as we do not know the name of the variety, it would seem most appropriate to call it the Bulletin Smyrna, to distinguish it from other importations. But Mr. Parker choose to submit the fig for a name to a physician interested in horticulture, who named it *Elemi*, and defended the name because it was one adopted by the Smyrna growers on account of the similarity of the color of the fig with the color of a resin called Elemi, and cites the Dispensatory for his authority. If Mr. Parker had submitted the question to the State Board, it would have known that the word used on the imported boxes is Eleme and not Elemi, and that it simply indicated that the figs were hand pulled. To call a fig an Eleme fig is as ridiculous as to name a peach a sun-dried peach. Eleme is a corruption of the word "Elleme," meaning hand-picked or pulled. See "Pharmaco-graphic," by Flecker & Hanbury.

I hope there are others beside myself who are experimenting in growing a seedling Smyrna. To such I say, do not be discouraged. A theory is not a fact. You alone can determine the fact whether it is possible to grow a true Smyrna from the seed. Think what a benefit it will be to the State if successful, and be hopeful. If you succeed, think of your reward; living, you shall win renown, dying, you shall be remembered by those whom you blessed, and shall depart with the sweet consolation that you left the world better than you found it.

Mr. Parker: One word further in regard to the name given to the Bulletin Smyrna fig. In justice to Dr. White, I would say that the first I ever heard of the name "Elemi," or whatever they call it, given to this fig, was in a letter I received from Dr. White (I think it was about the time of the Convention at National City) asking me if I had ever named the fig. I told him that it only had one name with me that I knew of, and not being a fig expert I still continued to call it the Bulletin Smyrna fig, from the fact that the "Bulletin" had imported the cuttings from which the figs were grown in 1882. Dr. White suggested that name, giving his reasons, on account of certain characteristics of the fig that bore that name in the country from which it was brought.

After discovering the value of the fig which I have the pleasure of growing, I wanted to ascertain how to cure it, so as to make a marketable article of it. I read, and the more I read the more I became befogged, because there were so many processes reported to be the process used in Smyrna. So I went to work with my figs; I dipped, I scalded, I put them in brine, I dipped in alkali, and the result was I fed them to the hogs. They were not worth anything. That was my proceeding a year ago this summer, and I could make nothing edible or anything like the Smyrna fig; so the last picking of my figs, a year ago this fall, I simply gave them a very slight sulphuring, and threw them on a tray, placed them on a shed in the sun, and gave them no further attention for several days, when I went to look at them. I found that the color was very different from what I had before, which led me to examine them and to care for them from that time on until they were matured; and the result was I produced a very excellent fig, in my opinion, to eat; and I concluded this year I would try to see what I could do with them by the simple process, and have succeeded in making what I esteem to be a very admirable fig.

I do believe that California in the future will excel Smyrna in the fig product, because we have soil and climate, and everything else favorable, and you will find that it is the natural home of the fig. It is bound to be one of the greatest industries in this State, equal to the raisin industry. I am not here simply to defend the fig—I don't care a snap what you call it; I want to show you what it is. I am not in the nursery business, but I am an enthusiast in my desire that you should get the very best that you can here in California; I believe in making the very best of everything that I can, and to give any information that I can in regard to the cultivation of the fig. I have had three years' experience with this fig, and I have none other, but in regard to pruning I will say that I have cut these fig trees for propagating purposes, for two years, clear back to the bare posts, and they have put out each time and made a tremendous growth; and the fruit has improved each year, particularly in size, showing that the very severe pruning has been a benefit to the fruit, and furthermore the fruit is heavier this year in saccharine matter, and seems to be sweeter. Now, one word in regard to the process of curing them. As soon as I discover on the tree that the figs are ready to pick—that is, when they are a peculiarly yellowish color, and there will be sometimes streaks of white (you soon become expert in ascertaining when they are ripe very readily by holding a fig for a moment)—I place these figs on a tray, one above the other, and in my bleaching box which I have for fruit, as these are cured at the same time I was drying peaches. The box was filled with trays from eighteen inches from the ground to the top, and as I never had but one tray of these to bleach at a time, that tray went on top of all the rest of the fruit, clear away from the fumes of the sulphur, so that no fumes could reach the fruit. All the sulphur I placed in the bottom of that box was two tablespoonfuls, on a little bunch of paper, which I ignited, and I left these figs there until the fumes of those two spoonfuls of sulphur had exhausted, which was ten to fifteen minutes, and every bit of the smoke that went up to this fruit was perfectly cool, and none of the blue flame or yellow flame came near the fruit. It is a hard matter to detect in two hours after they come out any signs of sulphur. That is all the sulphur that they have had, and if we can produce something better by sulphuring, why not do it? Some will have nothing to do with it, because they do not sulphur figs in Smyrna; but because they follow there the process of one thousand years ago, must we follow it, even though we can invent a better one? I believe in progress, and that we can improve on these old processes, although we may have to experiment a long time before we arrive at perfection. In regard to propagation, it is the simplest thing in the world. You can take a fig tree and make a tree from every bud on it, they are so easily propagated. Take the buds and plant them under certain conditions, and you could make at least 95 per cent grow and make a tree. There is a gentleman present who visited my propagation bed where the buds were planted this spring. One single bud stands an average of five feet six in height, the growth this year; and how long will it take them to be trees? And those very cuttings stand with fruit on them this year. They are the most vigorous growers and the most prolific in fruit I ever saw. Those that were planted out three years ago this spring one inch in diameter, three feet in height, are standing twenty-six inches in circumference just above the ground, and are fifteen feet high, well branched and well formed. It has been said that we have three crops of figs. I don't know anything about that. These began to bear, and the fruit ripened this year so that I picked the first on the twenty-fifth of July, and they continued bearing until the last rain storm (about October 10). I knew of no cessation, particularly, in the bearing of these figs during that time, and could not discover any indications of a first, second, or third crop. Your judgment will tell you how often to pick, but I picked mine perhaps twice a week. I found that in the hot weather they ripen more rapidly; as the weather gets cooler they are slower. I rejoice to find other figs in this country that compare favorably with this, and I shall be glad if anybody has a better fig to heartily congratulate them.

Mr. Maslin: I say we are liable to be in great confusion unless we start right. So with Mr. Parker's fig (which is a superior fig, and he must have the pleasure of putting it upon the market), it should not be called this fig or that fig, as the White Adriatic, and the White Pacific. I brought this up purposely, so that it may be determined. There are some rules laid down by the United States Experimental Station for the naming of fruits, and we want to start right, so as to have short names and distinct names. The leaf generally of my seedling Smyrna is like that [showing], double-lobed, unlike anything I know of in the State.

A Delegate: I request that the Secretary give the result of his observations and experiments with figs during the past season.

Mr. Lelong: During the early part of the season I undertook to investigate as to the different varieties of the fig. The main reason for this was that growers seemed to be confused as to the identity even of the most common varieties. I received, perhaps, as much as a ton of fruit through the mail for identification, and yet samples of the same variety coming from one district, or within, perhaps, five or six miles, differed so much in general appearance as to cause one to think they were several distinct varieties; so that the only thing to be done was to visit these localities and investigate. I went down as far as San Diego, and found there, with the aid of Commissioner Kimball, a fig known as the White Pacific, grown under such conditions that the fig was large, and in many instances, you might say, oblong. The skin was reduced greatly, and the quality excellent, the cavity inside being very small. Then the characteristics of the tree were not the same as of those found in other districts of the same variety. The growth generally was short, but the figs fruited on the new wood as well as on the old. In Downey, Los Angeles County, I found three varieties growing. They had labeled one variety under two names, and the party growing it had not distinguished it from those grown under different conditions, grown on the low land, which produced a larger fruit than on high land. The growth of those on high land was retarded, due to lack of water. The leaf was small, and the fig appeared to be a distinct variety. The party gave it a popular local name, while the other trees grown on the low lands he called Smyrna. It is the White Marseilles.

Two varieties of the "Bulletin" importation can be seen all over the State. Those varieties are very easily distinguished, and are very well distributed all through California. The types are so different that they can be very easily distinguished from any other fig tree. I want to say here, that it is very difficult for any one to determine the true type of the leaf. You must study it for some time before you can determine the true type of the leaf as well of the fig; and a person attempting to identify any variety simply by the foliage and shape of the fruit will make a great mistake. I once showed a botanist two leaves and jokingly told him they were from different trees, and I said: "Count the veins and tell me the difference." He answered me: "Botanically I find a difference." And when I told him that they came off the same tree, he was, indeed, greatly surprised. I also took the cells of two figs and placed them under a microscope, and they differed so much that he became satisfied that there was also a difference in the two figs which were cut off the same branch. You will find these little differences in all fruits of the fig.

A party having over two hundred trees of the "Bulletin" importation told me he was thoroughly dissatisfied with them and was intending to root them up. I went out and looked at the trees, and told him: "These two varieties are distributed all through California, and even in their native country they have never been known to produce fruit under eight years." These were about six years old; and I also said to him: "If you wait another year or two you may get a fig that is much better than anything we have in California; and if you dig them up now you will not have the satisfaction of knowing what you have got." So he concluded not to dig them up for two years. "But if they do not bear in two years," he said, "they will be dug up."

In the Vacaville district there are many large trees of this same type. One of the trees I have just referred to is a beautiful one; I have never seen any, except one out here at Mr. Roeding's, that would compare with it in the way it grows. It grows in the form of an orange tree; the limbs are not long like those you see on some trees, where they bend down to the ground and never lift themselves up again; but these limbs grow upright. Here at Mr. Roeding's there are more varieties of the fig in cultivation than in any other place in California. There are perhaps between twenty-five and thirty varieties now fruiting, but, with few exceptions—the White Adriatic and one or two others—they are not suitable for drying, but are valuable for table use and for crystallizing purposes. The San Pedro is one of the finest figs we have in California, but not for drying. The first crop is the largest of all; the second crop is one that is very much sought after now by canners all over the State, and also by makers of the glacéd fruit. Figs are now being canned, and for this purpose a light colored fig, such as the San Pedro, is wanted. In the southern part of the State they use the Marseilles and the Brown Turkey for this purpose. In Yuba City they are using the Brown Turkey, and pay from $40 to $50 a ton for them.

I find that figs grown in the valleys have a large cavity. The fruits are large, and generally, when they are dried, show a very large space, as they shrink away. The seeds also vary so much that unless you examine them carefully you would be deceived in the variety. Figs grown on the foothills contain a much smaller cavity; I have cut such figs open which showed hardly any cavity at all; the fruits were small or of medium size, and the seeds small, and they contain much saccharine matter.

As regards processing, I may say that I tried every process I could find described in foreign publications. I obtained the publications of nearly every country in the world, as far as published; it took me about two years to get them. All that referred to the fig were translated, and there is very little in the processes that we can make use of in California. The method of packing them in sacks and taking them on camels, and washing your hands in salt water, is all bosh. We can't do it in California, and I wouldn't do it if I could. I tried perhaps twenty different processes this year, and spoiled tons of fruit in experimenting. When I discovered that I could not use a process to advantage, one that was cheap and that any one could use, I threw it aside; I had no use for it. Almost every foreign process as given out through their publications, is misleading. I found in the publications from foreign Governments, almost in every instance, something like this: "You should be careful to avoid American competition" on olive oils, figs, and on other fruits. Those are the first words that you find in the preface of the book. In most instances, the books are published there in this way: A premium is offered for a book written on a certain subject, and those written are given to the Government and filed away in manuscript form, and what is published, I believe is simply to mislead the people of other countries, and California in particular. I have letters from almost every Consulate throughout the world, where the fig, olive, and citrus fruits are grown, and they have told me that it has even been impossible for them to go and examine the archives of the countries, in which they are located, and get the facts; they invariably say: "We cannot get them." These papers are for the use of their own Government.

The process of curing the fig should be one that is cheap, and one that can be used by any one without too much manipulation; because if you are going to spend money to manipulate your figs, you might as well keep it in your pocket or in the bank, as they will not bring more in price. I made a great many experiments, but two of which are valuable and worth following. One is to allow the fruit to ripen—never picking the fruit until it is fully ripe on the tree—after the figs are shriveled, pick them and put them on trays; put one tray on top of another; carefully avoid bruising the fruit at all times; then treat them to the sulphur fumes. I have a heavy, flat, two-inch iron plate, which I heat with a little stove, and place the sulphur on the top of this iron, and in less than five minutes the box is entirely filled with fumes. In ten minutes the sulphur has had its effect, but the fruit is not then withdrawn; it is left in the box at least fifty minutes longer—in all, one hour. The sulphur fumes generate heat; the fruit should go through an artificial sweating process. In about an hour you will find that by this sweating the skin is greatly reduced. These trays are then laid out in the sun. I used no drier. I have abandoned the idea of drying figs in a drier; you cannot do it; they are just the same as raisins; you may succeed in making first class raisins in a drier, but I have never seen it done. After the figs have been out an hour or so, they are turned over to allow that part that rested on the tray to become bleached; after they have become bleached they need not be handled for at least a couple of days; after that time, the more they are handled, rolled between the fingers, the nicer they will be. After, say about four or five days, if you have hot sun, the figs should be taken in and placed under a shed or in a house where there is a strong draught; they dry then very quickly. I put them under the shed in the draught after they are dried, but not hard; if allowed to lay in the sun until they get very hard, they cannot be softened again without artificial means. As soon as the figs are dried, I put them into wire baskets and dip them into boiling water. Instead of using any prepared material, after having tried almost everything that was recommended, I came down to the simple process of pure water, and find that it is the best of all. It must be boiling. Into this boiling hot water I immerse the figs two or three times, and turn them out just as pink and as pretty a color as you would want to have them.

A Delegate: What is that for?

Mr. Lelong: That washes off all the dirt, kills all the germs, fills up all the pores, and the figs become a nice pink color. You will find that in this process there will be at least two colors of figs, for the reason that those figs that are shriveled considerably on the tree will become darker, while those that are just perfect will become of a light pinkish color. You will have two grades of beautiful figs.

A Delegate: Are not the dark ones the best?

Mr. Lelong: They taste just the same; you cannot tell the difference. The only difference would be that of color. I will show to the members of this Convention figs prepared in this way, with no other processing but the hot water. The figs contain enough sugar, which in time crystallizes on the surface. If you want to give more gloss, you could put a little glycerine into the water. [The figs so prepared are shown to the delegates for their inspection.] I would like to state that all these figs are of but one variety—the White Adriatic (Cal.). In conclusion, I will simply call attention to this fig, which Mr. Maslin spoke of as being called the Verdoni by Mr. Williamson, or some one. It is one of the unknown varieties. It is of a beautiful amber color. For drying purposes I could not determine its desirability, excepting this: that it is white fleshed, and white-fleshed figs do not make as good a dried product as a red-fleshed fig.

Mr. Maslin: That is another illustration of these confusions into which we fall. Mr. West is, and has been for years, one of the most extensive growers of figs, and he wrote me that he had imported the White Adriatic as the *Ficus verdoni*; and I saw, not long ago, a catalogue in the State Library describing the White Adriatic as the *Ficus verdoni*. Now, here is another gentleman who calls a distinct variety the Verdoni fig.

Mr. Lelong: If I understand Mr. Williamson, he got the fig from Mr. West, and in the essay he read at Sacramento, he wrote about this fig, which was supposed to be the White Adriatic. He did not know what he had, as it had never fruited until this year; still he gave it the name Verdoni. Mr. West, I believe, claims to have imported it as the Verdoni.

A Delegate: Mr. West imported what is now called the White Italy as the *Ficus verdoni*, and Mr. Milco, desiring to have some fame, christened it the White Adriatic. There is no such tree known as the White Adriatic in Europe.

Mr. Lelong: No, there is no such name there.

Mr. Block: How many pounds of green figs will it take to make a pound of dried?

Mr. Lelong: That depends entirely upon the state of the fig; however, about three pounds, more or less.

Mr. Denicke: What we call the White Adriatic comes from foreign countries, and is called there Carignion. The fig we call here the Smyrna, which is an inferior fig by far, considering the thickness of the skin and the size, is the Biolitza. Now, as we have gone wrong in calling this the White Adriatic, I think it is best to leave it as it is, and to call any other variety, of which there are many, by any name we see fit. We are as much entitled to call our figs by their own name in California as they are in any other country. A remark was made awhile ago about this word "Eleme," which is a Turkish word, and signifies plainly select; anything select is eleme.

Mr. Lelong: There is a young gentleman here, Mr. Tcherassey, a student of the College of Agriculture, at Constantinople, and I think he can tell us about it.

Mr. Aaron Tcherassey: I cannot express myself very well. I did not study this question of fig culture in Turkey, and I cannot give you any opinion with assurance, but I can tell that eleme is a Turkish word, as the gentleman says, and signifies no more than selection, and may be no more than one kind of selected goods. That is what I know without a particular knowledge of the kind of fig. I know that in Smyrna there are commonly only two varieties of figs, Lubia and the Bultizicar. They are very good, sweet figs, and the Lubia only is exported to foreign countries. There are not many varieties—only two—and the cultivated area of the fig is not very extensive, only about Smyrna and in some place about Itua.

J. S. Dore, of Fresno: I think that the secret of making a good fig, a better fig than the average of those that I have seen, lies in the curing. They should not be dried too much; most figs are dried until they are leathery, and present anything but a nice appearance, and then they are not put in sufficient quantities to sweat as we do our raisins. My idea is that the fig should be dried, but not too dry, but just so that they will keep, so that they can cure. That can be determined by an examination, or by experimenting, perhaps. They should be then put in boxes or packages of fifty or one hundred pounds, or more, and allowed to sweat in the same manner and for the same purposes that a raisin is cured; then, when taken out from the sweat box they are very moist, very damp; you would think they were all going to rot, but you open them up and air them a little, and they will come out all nice and dry, and then they can be packed in boxes, and you will see the product like the boxes that are being passed around. I tried dipping some in salt water, but I thought I could taste the salt, and I did not exactly like it. I sulphured some for a long time, and then put them in hot salt water, and it made them too wet. I think that by treating them as I have described they will keep, with that jelly-like appearance that is desired. I think the figs should either be picked off with the thumb and finger, or cut off with a knife, or something of that kind, so as not to break the skin of the fig, and then when laying upon the trays I think they ought to be some distance apart.

FRUIT DRYING.

Essay by J. L. Mosher, San José.

In considering the process of curing and drying fruit, we can scarcely comprehend the magnitude of the subject. In looking back over the Horticultural Reports we see how fully and thoroughly these subjects have been discussed; yet each year brings us fresh experiences. Indeed, I think the time is not distant when the drying of fruit will revolutionize the canning industry.

The bulk of our dried fruit is dependent on the eastern market, and we are trying by quality and attractiveness to increase the demand for our products. To a great extent the attractiveness is carried too far, at the expense of quality. Take the apricot for instance. I will vouch for the statement that but few eastern people really know of the rich juicy flavor of the *ripe* fruit. Picked while green, and left to ripen while traveling several thousand miles, to arrive in an insipid, tasteless state, to be no longer recognized by a Californian as one of California's choicest fruits, compared to the *ripe* fruit just picked from the tree. No wonder the eastern gentleman, who once visited our Horticultural Society, made the remark: that "the first apricot I ever tasted, I bought from a Chicago fruit stand for five cents; I threw it away, exclaiming it was nothing but a species of squash."

It is claimed by many dealers and growers that the demand for the dried apricot is decreasing, and to some extent this is true. I attribute this to the erroneous idea that the fruit must be picked before entirely ripe, and over sulphured, making a white, presentable article to look at, but bitter and astringent to the taste. Who among us would think of picking a half ripe apricot to eat out of hand, in preference to one fully ripe? And what holds good in the green fruit will be exactly the same in the dried product. And yet there is a better demand at better prices by most buyers, for the unripe, over-sulphured fruit. This is discouraging.

Last summer a buyer left me a sample of the unripe, bleached article, and said: "If your fruit was as white as this I could pay you a higher price." I laid it with my thoroughly ripe fruit on the table. On my return a few hours after, I found my fruit covered with hundreds of ants determined to carry it away, while they entirely avoided the buyer's sample. And again, ripe fruit, on account of the accumulation of sugar, weighs heavier than the green, which is an object.

For the ripe and properly cured apricot, the demand should be unlimited. When our customers more fully learn the value of rightly prepared fruit, and we ourselves the way to prepare it, the consumption will increase.

One of the things most necessary and largely neglected is the proper grading of our fruits before drying. It saves labor and the fruit dries evenly. The fruit should be kept separated and sold in its different grades. This will be more satisfactory and remunerative, besides giving the producer a standing for his fruit. But if left ungraded, the small fruit is dried up and shriveled before the larger is cured. This fruit must be sold at a lower price or must be assorted; and even then the small over-dried fruit will be a loss in price and weight. If the small fruit is graded out and properly dried it will make a good salable article.

Sulphur.—I claim the true flavor of the apricot is in its deep yellow color, and this is obtained by its ripeness, retained by sulphuring. As soon as cut and exposed to the sun and air, fermentation soon takes place and the fruit turns dark, sometimes black. Proper sulphuring will stop fermentation and retain is original color. We know that sulphur fumes and sulphuric acids are poisonous, and if sulphured fruit were eaten as soon as removed from the sulphuring box the results might be disastrous.

As the fruit is evaporated, so also is the sulphuric acid, and I believe if properly sulphured fruit were analyzed, there would not be found enough sulphuric acid in a large quantity of the dried fruit to kill the native Californian—the flea.

If fruit be picked before ripe and over sulphured to produce whiteness, it is devoid of its true rich taste and flavor, *and only requires polishing to make buttons.*

When I say that the time is not distant when the drying of fruit will revolutionize the canning industry, that is not too strong an assertion. Properly dried fruit will, at the present time, excel the ordinary grades of the canned article, and each year, with our new experience, we will obtain a supremacy never yet reached. The great object to be obtained is, to retain in its different stages of drying the natural virtues of the fruit, and to learn where and what are the changes that take place.

Mr. B. M. Lelong, our Secretary, has added to his office an experimental room, and is fast becoming a living encyclopedia on this subject, and in time will make some valuable disclosures.

DISCUSSION.

MR. HATCH: There is no one in California that has put up as pretty fruit as I have seen of Mr. Mosher's. I don't want to compete with him; I want him to dry my fruit for me.

MR. THISSEL: I have had considerable experience in drying fruit, and, like Mr. Hatch, I don't think my fruit compares with Mr. Mosher's; therefore, I think I can take a lesson from him, instead of trying to instruct him.

MR. HATCH: If Mr. Mosher's plan is practicable on a large scale, and I do not know why it should not be, I think the sooner we adopt it the better, providing it only tastes as well as it looks; it need be no better.

MR. LELONG: I want to state, Mr. President, that Mr. Mosher's business is on a large scale; he dried over five hundred tons of fruit this year.

MR. MOSHER: I would like to say I have a few cans of fruit, which was dried here in Fresno over a year ago, and was put up in cans about four or five months ago, and I had forgotten about them until I started down here; you can open them and see how they compare. I wish we had some grades of canned fruit to compare with them. This fruit has been dried and laid nearly a year, and then it was cooked and canned in the shape you see it there.

MR. HATCH: What is the idea of canning dried fruit? Is there any reason why it should be done?

MR. MOSHER: I think there are a good many good reasons. In the first place, I think in the future we are going to get better fruit by drying, for the simple reason that we can dry the fruit when it is very ripe. I think we cannot get our fruit too ripe. Now, one little can of fruit holds two pounds and a half of the dried article; there will probably be of peeled peaches, fifteen jars of fresh fruit in that one little package that only weighs about two pounds and a half. I think that would be quite an item on freight alone. I would can it at its destination. If you figure up the freight on a carload of dried fruit, and the many carloads it would make after shipping, it would be quite an advantage in freight.

A DELEGATE: What is the advantage of canning it at its destination?

MR. MOSHER: Saves in freight and cost of packages.

MR. HICKMOT: Don't you think that will be a great detriment to the selling of California green fruit in cans? It certainly is not as good as fruit that is canned green. Take green fruit in its proper condition and can it, and then take dried fruit and ship it East and can it, and it is going to give a very black eye to California goods.

MR. MOSHER: That may be, but I think now that this canned fruit will far excel the ordinary grades of fruit that are put up in California.

MR. HATCH: Some years ago I used to think that if I ever did get enough fruit to run a cannery, that I would want a cannery at my own place; but before that time came I decided like this: that while it took one pound of green fruit to make two pounds of canned fruit, it would take five pounds of green fruit to make one pound of dried fruit, and that was as one pound is to ten in freight, and we would necessarily have to dispose of large quantities of fruit, and the freight item would be an immense one, and make it almost impracticable to depend on canning alone for our market. I think that we ought to improve our methods of drying to such a degree that our dried fruit, when placed before the most fastidious, will be such that he will say it looks good enough to eat. Take such fruit as this and stew it and put it in a glass plate, and it will look good enough to eat and taste good enough to eat; it has every quality that is necessary to make it desirable to those who want fruit, and it would be only a wild notion that any one would want that fruit put up in cans. It would be so much nicer to keep it in a little package. It looks to me like a proposition that would not be desirable to follow.

Mr. Aiken: One point made by Mr. Mosher was: Take, for instance, a green plum; they can it; if it is ripe, they dry it, send it East, and afterwards can it. The question is, which is the better fruit—the hard, sour, egg plum, canned here, or the ripe fruit dried here?

Mr. Hickmot: I would like to deny the statement that the canneries can a green egg plum. We can the yellow egg plum when it is in a fit condition to stand; we do not do it otherwise, because it is not merchantable. We have got to get the color in the cooked plum to sell it, and we get it as near as possible in a perfect condition—not too green, and we do not want it too ripe. If you take a box of dried fruit and go to put it in cans, I will venture to say that not over 20 per cent can be used for canning at all. It must be well selected to make a merchantable article. We all know in making up a box of dried fruit, the top layer is very nice and the underneath not quite so good; and when you come to put it in cans to be criticised, you will find it is not quite so profitable as you may think. I want to state that there is an erroneous idea throughout the United States that the canneries will use everything that comes in. If we did that, it would take but a short time to ruin our business. I believe that sulphuring the fruit is the greatest mistake in the world. I do it, as Mr. Hatch says, but I believe it is wrong; the flavor of the fruit is gone after it is sulphured.

Mr. Mosher: It is not my idea to be antagonistic to the canning industry; it is my belief that with our experience from year to year we will in time revolutionize the canning industry. For instance, the apricots which we sell to canners in our valley, I don't care how nice they are or how large they are, I would not put them up as my first class fruit. The fruit that I would put up the canners would reject, because it would be too ripe; it would not be of nice form, but would be soft. It was not my intention in this paper to advocate the idea that this fruit should be shipped East, and canned; if shipped East, and our customers learn to like it as well if not better than the canned fruit, they will use it in preference, and that will revolutionize the canning industry. So far as sulphuring is concerned, my friend says that the fruit is better unsulphured; it may be, but what kind of fruit can you get by not sulphuring it? This summer I have tried some fruit, sulphuring it ten minutes when it was very ripe. I sold it for 3 cents a pound. It was black, and I don't believe there is a man here who has had a great deal of experience in drying fruit that can take a real ripe apricot and produce a nice article without fumigating it. It will turn black. If it is cut while it is green, perhaps you might get a fruit that would not turn dark; but if you want to get the true flavor, it has got to be ripe, and if it is ripe, when you dry it without sulphuring it will turn black. I have one lot that is almost totally black, especially where it was overripe.

Mr. Kimball: I want to ask Mr. Mosher what is the effect on the flavor of the apricot or other fruit by sulphuring? Is the flavor removed by sulphuring or not?

Mr. Mosher: I could not tell. The very ripe fruit that I have sulphured I know is good, nice fruit; the fruit that I did not sulphur is unfit for anything, and I sold it for 3 cents a pound to make marmalade. I cut out the black part of it, the ripest part, where it is very dark, and they used the rest for some kind of a preparation—jelly, or something. With sulphuring, it would have been nice fruit, and I would have got probably 12 cents a pound.

Mr. Thissell: I want to give you a little of my experience in sulphuring; before I do I want to ask Mr. Wickson if he has ever discovered any traces of sulphur in the dried fruit that he has used that I have manufactured.

Mr. Wickson: I would like to state to Mr. Thissell that they were very acceptable, and freely used in the family, and used up very quickly; but I must acknowledge that I thought I could detect a little taste of sulphur in them.

Mr. Thissell: That is just exactly what I wanted to know. My plan of manufacturing my apricots is this: First I allow them to get perfectly ripe upon the tree; then we pick them, cut them, and as soon as possible after cutting, we put them into boxes and sulphur them. We always allow them to remain in the sulphur box according to the ripeness of the fruit; if extremely ripe, we sulphur thirty minutes; if a little green, we sulphur them a little longer. My sulphur boxes hold forty boxes of cut fruit; into them I put four pounds of sulphur and set it on fire; the box is closed up, and I let it remain the length of time which I have stated; remove the sulphur. And Mr. Wickson is the first man that I ever have heard that made any complaint in reference to the sulphur being upon the fruit. I am glad to hear him state what he has stated in reference to the matter, for the fact of it is that if it is injurious to the fruit, I want to know it. My peaches I treat the same way exactly, and I must say that I have had success in manufacturing dried fruit, and also sulphuring.

Mr. Mosher: I think the proper way to test this would be to have some good ripe fruit sulphured and unsulphured, and put the two in kettles, and have it cooked and passed around.

Mr. Hatch: It makes little difference what we have to sell, if it is only pretty and large. Take for instance our poorest grape and the poorest plum, in real quality; they bring the highest prices in the eastern market, and there is where our dried fruit goes. What is the difference whether it tastes good or not? The pretty always did bring the highest money.

Mr. L. W. Buck: I am not a person of any very large experience in sulphuring fruit, as I have not been at home at the season that the fruit has been dried. In conversation, however, with a gentleman who handles more California dried fruit than any other man in the East, we discussed the merits of both canned and dried fruits at the present day, as compared with those of a few years ago; and it was his opinion that the improved quality of our dried fruit is tending more and more each year to lessen the demand for California canned fruit in the East, while increasing the demand for our dried fruit over all eastern products. I asked him how he accounted for that, and he said that the improvement in the quality of dried fruit was making a fruit that was taking the place of canned fruit in the East. I asked him if other sections of the United States were making the same improvements that California was in her dried fruit product, and he said no, that with the exception of a very few localities that were furnishing a very fair evaporated fruit in the East, there was no improvement—there was no improvement in the sections that furnished the bulk of the dried fruit that is put up in the East, and the California fruit was supplanting it and taking its place as a fancy fruit. In reference to sulphuring he said he did not believe it to be injurious except when used to excess. In reference to what Mr. Thissell said, I would think that the amount of sulphur that he used would be rather too much; I know that it is more than we use, and further we do not put the sulphur under the fruit; we burn the sulphur in a sheet-iron stove with two pipes connecting the stove with the sulphur box, and as a rule we sulphur about an hour, but not with as much as four pounds of sulphur; and if you can detect the sulphur in the fruit, it is something I could not do, and I have often tried.

I have sometimes thought I could, but then I generally made up my mind later that I could not detect the sulphur, comparing fruit that I knew was sulphured and fruit that I knew was not. As Mr. Hatch has said, you have got to put the fruit in a presentable condition; you have got to dry good fruit, and you can only produce a good article by drying ripe fruit, and you cannot dry ripe fruit and make it of good color except to sulphur it. Further, in order to get the most pounds out of fruit, you have got to dry it just as nearly soft as you can; you do not want to leave it until it is mushy, but the nearer dead ripe it is the better the fruit, the more saccharine matter there is in it, and the more it will weigh; and for that reason alone I think that it is certainly desirable to use sulphur, but it should be used, in my judgment, a longer time and less of it.

Mr. Aiken: Will it preserve fruit better?

Mr. Buck: I do not know that it preserves it. Ripe fruit cannot be dried without turning black. If you take a piece of fruit, and open it and peel it, as soon as the air strikes it it is discolored; it gets dark; the longer it lies before it commences to dry, the darker it turns. The sooner you can get it from the knife into the sulphur box, the sooner you stop or prevent the discoloration.

Mr. Williams: The whole secret of sulphuring is to stop the oxidation or decomposition of the fruit; that is arrested by the action of the sulphur upon it, and, therefore, the fruit retains its natural color, or the color that it would have if discoloration did not set in as soon as it was peeled.

Mr. Mosher: I would like to state that it is my experience that where I put my fruit in the drier, I only need to sulphur about half the length of time that I do when I put it in the sun.

Mr. R. C. Kells, of Yuba City: I have had some little experience in sulphuring fruit. I began in 1879, on apricots. We sent our apricots to Chicago and got fancy prices for them. I think it was 22 cents we got that season, and it rather encouraged us in sulphuring our fruit, and we began to agitate the matter. Many of my neighbors thought it was injurious, and I was not quite satisfied myself as to whether I was on the right track or not, but I was under the impression, with Mr. Hatch and others, that it was money we were after, and if consumers wanted our fruit nice and bright we would fix it that way for them. In the meantime I thought I would exhibit some fruit to some of my relatives and friends in the East, and get their opinion in regard to the matter. I sent some dried fruit (peaches, apricots, and apples) to parties in Ohio and Michigan, and also in Iowa, asking their opinion as to the quality of the different varieties, and in every case I had the reply that the evaporated fruit was excellent, with the exception of one case from Michigan. The parties wrote me that the apples were not as good as theirs, having a peculiar taste they could not explain. They seemed to have an idea that all fruit was evaporated fruit. I was told afterwards in regard to the matter, that the sulphur in the apples gave them that peculiar taste. I am satisfied that we can over-sulphur apples and make them unpleasant to the taste, and eastern people will not like them; but our bleached fruit goes to the eastern market at the present day on a par with our evaporated fruit, if properly ripe before it is bleached and dried; consequently I say that we should keep on with our bleaching until our eastern friends tell us that we have overdone the matter, and then fix it to suit them in some other way. I will say that I prefer drying the almond and then dampening and bleaching afterwards; I think I secure a better result, and save the chances of spoiling them in bleaching when first picked, while the kernel is yet moist and some are green.

Mr. Stabler: In drying fruit this season I found that the length of time between cutting and placing in the sulphur box had much to do with the color when dried. Where we had two persons cutting into a tray and filling it in five minutes, the dried product was much brighter than where one person cut and filled the tray in twelve minutes. It requires less time to bleach, and bleaches better.

Mr. E. E. Smith: There are two things we want in dried fruit—one is the highest quality, and the other is the largest profit. Sulphuring is a very important factor in the sale of our fruit, and I think we should adopt some means to arrive at its actual effects; therefore, I move that a committee be appointed by this Convention to prepare samples of dried fruit without sulphur, and samples dried with different quantities of sulphur, and to test these samples and report thereon to this Convention.

Mr. Maslin: I don't know much about sulphuring the fruit, but I have been a persistent reader of the reports of the Horticultural Board and of the Fruit Growers' Convention for the last six or eight years; and now this question is brought before this society, you want to get at a fact, and here my remarks will be pertinent to the motion. I think I can indicate the course that that committee should take. We know how strong is the illusion of the eye; I tested that the other day, if you will pardon me for stating the experiment: A friend of mine thinks he is a connoisseur in liquor (there are three things a man thinks he knows all about—one is the taste of liquor, one is a horse, and the other is the beauty of women). I told this friend that he could not tell brandy from whisky with his eyes shut. We went into a saloon, and the barkeeper brought out what he said was French Cognac and some good Bourbon, and let my friend taste the liquor with his eyes shut, and he could not tell the difference between them. I will tell you another thing: You take a cigar in the night and smoke it, and you can't tell you are smoking unless there is a light brought to see the smoke; it is the illusion of the eye, as I said. Now, you want to establish this fact and decide this question, and I suggest that it be left to men who do not know the fruit they taste. It must be unprejudiced men, who judge by the taste, and not by the eye.

The appointment of a committee is indefinitely postponed.

A Delegate: I would like to ask as to methods of dipping prunes?

Mr. Mosher: I have no especial method; I merely dip my prunes in hot water with a very little glycerine. I put them in a bin after they are dipped and let them stay there fifteen or twenty hours, and shovel them over and let them cool off, and after they have sufficiently cooled I pack them or sack them. I would like to state what I am trying to impress upon our growers, I hope to their advantage: the difference between bright goods and ripe goods; that is, we know that the market has a good demand for bright goods, but is that the best fruit? In my estimation it is not. It is the ripe, big yellow fruit, that is the richest; that may be bright, but the fruit that I have seen this year is what I call unripe; that is, apricots ripe on one side—the Moorpark, especially in our vicinity, and we raise mostly Moorpark—one side beginning to get ripe and the other quite green. This, when cut and sulphured, is of the whitish color, but if it is left until it is perfectly ripe it is of a deep yellow. I think almost every one would, if they cooked this fruit for their own use, prefer by far the perfectly ripe, big yellow fruit; I certainly do.

A Delegate: Which commands the highest price?

Mr. Mosher: My experience is that the fruit that is a little green, a little whiter, commands the better price, and, I think this is where we are making the mistake. I claim that if the demand for apricots is decreasing, that to a great extent is the reason; I think that when our eastern customers begin to be governed by taste a little more than by their eyes, it will increase the demand for dried fruit, because I am quite certain that any one who has eaten ripe fruit will prefer it. Of course, the ripe fruit should be bright, but I think that is what Mr. Buck means.

Mr. Buck: Mr. President, I am surprised that a man that has dried as much fruit, and is as good a judge of dried fruit, and has made such fine dried fruit, would think that there is any question as to what makes bright goods; bright goods is only made from ripe fruit, and it is that bright golden color that gives the apricot an appearance that can only be made from ripe fruit; you may take a green peach or a green apricot and you can only make a dead white looking fruit out of it, I don't care how you serve it. It will dry white, it will shrivel up, and will not have that clear gummy preserved appearance that nice ripe fruit will have.

Mr. Hatch: Now let Mr. Thissell tell us how he makes those prunes so nice that he had at the State Fair.

Mr. Thissell: I was going to tell this audience that there is one rule that can be laid down that there is no mistake about in reference to making money out of green and dried fruit. It is this: if one wants to be successful in selling his fruit in the local or eastern markets, he wants to pack and ship just such fruit as he himself and his family want to use. My dried fruit is all contracted for three years hence, and I find that the dried fruit that my wife and I like on our table Mr. Wickson likes on his, and that is the rule that I have laid down in manufacturing my fruit and in putting it on the market. Now in reference to those prunes I had at the State Fair and received the premium on. I do not think they compare with Mr. Mosher's prunes that I see here; I think he probably would have got the premium if he had been there with that fruit. However, they were very nice prunes. I picked them from the trees when thoroughly ripe, then I dipped them in a solution or a preparation of thirty pounds of water and three pounds of concentrated lye; then I washed them thoroughly and rinsed them off with clean cold water and put them out, and when they were perfectly dry put them in sixty-pound boxes and let them remain there about four or five days; then I had a solution of thirty gallons of water, one gallon of Golden Drip syrup, and two gallons of glycerine; in that preparation I dipped my French prunes, and then put them out and dried them. One thousand boxes of the prunes I sold. Every prune in the box was exactly alike; whether they were fancy prunes or not I do not know, but I received a good price for them, and I am satisfied.

Mr. Mosher: I would like to say in regard to my prunes. I dipped them in the usual lye and put them in boiling water—I have an engine and kept the water running continually—before I put them in the sun. I agree entirely with Mr. Buck in regard to the color and the fruit, but I know that in our valley a great deal of this fruit is dried when it is what I call unripe, and I know it makes a whitish fruit—looks rather nice, but I don't think it compares with the ripe fruit; but still I know buyers have looked at my fruit and passed it by, and offered my neighbors better prices for this very same unripe fruit. I know some of it has been sold, and they preferred it, because it is more merchantable; and because it looks better and sells better. I think evaporated peaches are a good deal the best. I think there is as much difference between an evaporated peeled peach and a sun-dried peach as there is between the common sun-dried peach and canned fruit. The thoroughly ripe peach when peeled and evaporated, if it is properly done, when properly cooked has no dried fruit taste. I can take evaporated fruit and cook it so that you cannot tell it is dried fruit, unless you see it.

Mr. Hatch: I will ask, Mr. Mosher, how do you peel your peaches?

Mr. Mosher: The most of the early peaches we first cut and pit, put them on the trays and run them in the sulphur house; we sulphur them, I think, about an hour, and then we bring them back into the drying room, and the sulphur loosens the skin. The peach, if sulphured that way, is full of juice. We take a knife, and take hold of one edge of the skin, and it peels right off, and we lay it back on the tray; we keep the cup side up, and it comes off very easily.

Mr. Hatch: Does one motion take it off?

Mr. Mosher: Most generally one motion. If there should be a little green spot on the peach, sometimes it will hold. We find that we can peel them that way twice or three times as fast as with the peeler, and save a great deal of the peach. It is very satisfactory, but there is one thing I will caution you: that in doing this, you must run them back in the sulphur house for five or ten minutes after you peel them, as sometimes a part of the peach will not be sulphured through the skin, and it will turn dark.

Mr. Hatch: Can you peel freestones and clingstones equally well?

Mr. Mosher: Yes, I think so. We were very successful with all we tried to peel this year. They must be very ripe. We did not dry very many clings. I was not successful in getting the pits out of clings.

Mr. Williams: I think you will have some difficulty in peeling clings that way. In looking round for dried fruit this year, I found a little machine at Lemoore, which was pitting about as rapidly as forty men could. It seemed to be two cylinders running together, cutting the peach open, letting the halves drop on the tray, and the pits falling below. It was very successful, and I should be glad to know more about it.

Mr. Thomas: That is Evans' fruit pitter from Alameda; I worked one of them last season and also this; last season it did not work satisfactorily. He came up this season and made an improvement on the knife, and it then worked first class. There are two small, circular saws, and when the fruit is put in a hopper and run in, one of them goes on either side, and it takes about four boys to take that fruit and spread it on the tray. If you are careful, you can guide the fruit with one hand and cut it straight through, and never know the difference when it is dry. If you are careful, you can catch the peach as it drops in. It is the best thing to save labor I have ever seen.

Mr. Mosher: I spent a great deal of time hunting up a machine to pit apricots. That fruit always comes in a hurry; a great many of them at one time, and I finally came down to this [showing a sample]. The way I use this, is to nail it on to the table or on to a block that is slipped on to a tray, and pick up an apricot and place it in this little groove. The knife is about half round, and when you place the apricot in there the knife cuts about two thirds of the apricot; give it a little turn in your hand, and it makes a clean cut all around, and you then push it, and the pit drops out in a little hole and the apricot is right there. I have cut and pitted forty a minute right along by the watch, and I think it is a perfect pitter. I don't think this will work with even the freestone peach, for the pit clings to the meat; but the apricot is loose. These are very cheap, $4 a dozen. They are made of steel.

RESIN SPRAY AND ITS EFFECTS ON CITRUS TREES.

Essay by J. H. Kellom, Tustin City.

As the essays read before this Convention of fruit growers are supposed to take their color from the localities in which the writers reside, we shall confine this paper to the discussion of the two varieties of pests which have imposed great damage on the orchards of Orange County, viz.: the black scale (*Lecanium olea*) and the red scale (*Aspidiotus aurantii*).

The black scale, so far as we know, may be counted among the "forty-niners." At any rate, their dusky tents were pitched in the citrus groves ten years ago, according to our personal knowledge. Not regarded as a pest at that early day, they were treated with impunity; but by and by, as the scale increased, the fruit became smutty and its value depreciated in the markets. Bright fruit was found only on trees free from black scale. By the yearly application of whale-oil soap, petroleum emulsions, and other washes, propagation was checked, but not averted. Extermination was waiting for a new insecticide, and that was found in the soda-resin spray. By two applications of this spray the orange orchards of Tustin are ostensibly freed from the black scale, and this riddance adds at least 25 per cent to the market value of the crop. In other words, the extra price more than pays the cost of spraying.

RED SCALE.

We now turn to the red scale, which is "a gray horse of a different color." This pest originated in one or two nurseries in the town of Orange, which were supplied with stock from Australia. For some years it made but little headway. To-day it is regarded as a bane, a plague, a poison, a pestilence, and a fatal epidemic. It defiles and dwarfs the fruit, causing it to drop, blanches the foliage, blights the limbs, and ultimately kills the tree. It is prolific in progeny, which is so atomic in size as to elude for months both the eye and the microscope. Its transportation is by birds and bees. Arriving at its new home, it makes no sign, but lurks in ambush.

The white scale and the black unfurl their banners and charge the parapets in front; the red scale steals in from the rear, takes possession of the works, and then raises its colors.

A seedling orange orchard in the suburbs of Los Angeles, twenty years old, bearing fruit worth $4,000 per annum, appeared on the first day of May last as grand and green and glorious as any grove in Southern California. During the spring one fourth of the fruit had fallen. The owner supposed this was the result of white scale, with which some of his trees were infested. But he was mistaken; the red was there, and probably had been for more than a year. On the seventh of August we examined the grove and found one fourth of the foliage dry and dead.

The summer months reveal to the eye the work of the previous winter. At first just one dry twig, a few spotted leaves, more dead limbs, and finally the tree top is blighted as by fire or the scathing of lightning.

One third of the trees of Orange County have been thus cursed, and are now cut back, leaving only a skeleton or trunk, which is scrubbed and whitewashed. The remaining two thirds are more or less tainted; to these have been applied whale oil and soda washes, with varied strengths, but with indifferent success. The newly hatched at the time of spraying were killed, but their places were speedily filled by their younger brothers and sisters. A spray strong enough to penetrate the shell would harm the tree. Soda and petroleum were good enough ammunition, but we dare not fire them for fear of killing our friends.

Such was our predicament fifteen months ago. Appalled by this cyclone, before which grove after grove disappeared, alarmed at our losses, dismayed, because helpless, we cried out in dispair: "After five, ten, fifteen years of work, worry, and waiting, the fruits we gather are but the apples of Sodom."

SODA-RESIN SPRAY.

The soda-resin spray was first applied in a business way and on a large scale, on the orchards in Tustin, in September, 1888. At the fruit growers' meeting, held in National City last April, we gave an account of the use of the spray on six months' trial. We felt at that time that a round year, including the hot months of June, July, and August, was requisite in order to form a correct estimate of the new remedy. A year and more of observation and experiment has now passed, and we stand before you abreast of the improvements and the latest applications of this valuable insecticide.

Some statements then made and theories advanced must now be modified. It was our opinion, as expressed at the April meeting, that 95 per cent of the red scale were killed by this soda-resin spray. Observations for the past six months do not justify so large a percentage; nor do we find the spray equally potent on fruit, stem, and leaf. On the lemon fruit not over one half of the pests are destroyed. On the orange, about three fourths; on the stem, 95 per cent, and on the leaves all succumb. This proportionate fatality is not easily accounted for. Why such persistent vitality on the lemon and mortality on the leaf? Why are more suffocated on the orange than on the lemon? But are they *suffocated* on either? This question leads us to reconsider our theory of the mode of killing. It was the opinion of Professor Coquillett that the scale is destroyed by the exclusion of the atmosphere from the shell of the insect.

"The resin part of the spray forms a coating over the young hatched out and over the shell, and this film is impervious to the air, and so the scale is choked to death." This theory seemed plausible and involved no chemical action. Resin is a neutral substance and so also is soda when just enough is used to saponify the resin, as all its caustic properties are rendered inert in the process of saponification. The "modus operandi" being mechanical, all the credit was due to the resin, the water and soda being used in order to apply the resin. No wash could be more harmless to the foliage, or more economical to the owner.

Indorsing and adopting this theory, using no oil, simply water, soda, and resin, we sprayed two thousand five hundred trees last fall at an expense of 22 cents a tree, and the result at the time seemed satisfactory.

Partial as we are to this theory of suffocation, some facts already stated seem to antagonize it. Suppose a lemon to be immersed in the spray, after the expiration of two weeks or months, why are one half of the scale alive? Was not the air excluded from all alike? Contiguous to a live scale we find a dead one. Why is one taken and the other left? Again, in forty-eight hours after an orange is sprayed or dipped, we sometimes notice that the supposed young prisoners have got out from the shell and are seeking lots on which to secrete new homes, and set up housekeeping. On the air exclusion theory, how did they break jail? Again, rubbing the thumb over a sprayed leaf the dead are easily detached and slide off, when in fact they should be glued to the surface of the leaf.

There are two reasons why we are reluctant to abandon this theory:

First—It increases the cost of material, to the extent that oil and more soda must be used.

Second—As Hamlet is made to say:

> "It makes us rather bear the ills we have,
> Than fly to others that we know not of."

In flying to any other and all other theories, we are equally perplexed. When killed, the scale turns brown or black; this indicates chemical action. But why do the chemical agents knock at the door of one scale, and pass with indifference by the door of its neighbor? Do acids and alkalies propose to burlesque Darwin's law of the "survival of the fittest," into the survival of the worst?

It may be that soda is the potent agent, and that the office of the oil and resin is to hold it in position until it can do its work. If so, more soda is requisite than what is required to saponify the resin. This is the common theory, and perphaps the true one, but fails to solve the problem—why one is taken and the other left.

Leaving this conundrum with the entomologists of California, we now call your attention to the making of the spray and its composition.

The spray used by our folks in Orange County since October first, is composed of resin, soda, fish oil, petroleum, and water, in the following proportions:

Water	100	gallons.
Resin	17½	pounds.
Soda (60 degrees)	7	pounds.
Fish oil	3	pounds.
Petroleum	2	pounds.

October twenty-ninth I had ninety lemon trees sprayed with the following mixture:

Water	100	gallons.
Resin	20	pounds.
Soda	8	pounds.
Fish oil	5	pounds.
Petroleum	2½	pounds.

Directions for the first spray.—The resin, soda, and fish oil, with twenty gallons of water, are put together and boiled thoroughly for four hours, and then the coal oil is added and the whole stirred well. Boiling or very hot, this compound is put into the tank to which the pump is attached, and the remaining eighty gallons of water added. Stir the whole in the tank before, and occasionally while spraying. The emulsion is perfect and the spray flows freely. If the San José sprayer is used, the spray will be fine or coarse according to the orifice in the disk.

The petroleum is supposed to prevent the soda from burning and staining the fruit. When the temperature is between 80 degrees and 90 degrees, or above, less soda should be used, otherwise the leaves will fall and the fruit drop or be stained. In the coldest months, eight pounds of soda (60 degrees) can be safely used.

There are with us parties who make spraying a business. Their charge is 3 cents per gallon. Two good men, with a man to pump, will empty a four hundred-gallon tank twice per day. If the ground is dry, the orchard should be irrigated before or soon after spraying.

WHOLESALE COST.

The cost of material delivered at our depot is as follows:

Soda, by the drum, six hundred and fifty pounds	4 cents per pound.
Resin, by the barrel, two hundred and eighty pounds	2 cents per pound.
Fish oil, by the barrel	40 cents per gallon.
Petroleum	20 cents per gallon.

This spray is expensive, but cheaper than its competitor, the hydrocyanic gas treatment, discovered and applied by Professor Coquillett after patient laboratory work, involving one hundred and thirty experiments.

An intelligent rancher near Anaheim, who has the tents and all the appliances employed in the gas treatment, has abandoned them for the less expensive and more speedy remedy.

In conclusion, this insecticide is the best we have ever used—not all that we hoped from it in our report to you at National City. If it does not annihilate the pests, our hope is to tide our orchards over to the time when a parasite shall be found, or, failing in this, to worry the enemy by a Fabian warfare until Nature gives us the victory. But should Nature and parasite both fail us, we will continue spraying, and thus verify the sentiment expressed by Pope one hundred and fifty years ago:

> "Hope dwells eternal in the human breast,
> Man never *is*, but always *to be* blest."

Dr. Kellom: One year ago this morning I commenced spraying an orchard with the resin spray; the day before this Convention assembled here on Tuesday, I finished spraying that orchard the second time. Within the year the two sprayings have cost me $1,335 17, and I regard it as a good investment. The first spraying enabled me to sell my fruit for 15 cents a box more than my neighbors did theirs; the second spraying has put upon my trees oranges as bright as any to be found in Riverside. The two sprayings have saved my orchard, for if I had not sprayed I would not have had any grove worth spraying in a year from now. I have in my pocket an orange and a lemon. I desire to show the worst specimens I could find. This lemon is completely plastered over with red scale. It has been sprayed three or four different times. Nine days ago I made a spray the strongest I ever made; eight pounds of 70 per cent soda and twenty pounds of resin, four or five pounds of oil, petroleum, two pounds to the one hundred gallons of water, and put that on that lemon; now you see the brown appearance. I judge perhaps that every scale on that limb was killed, but they are not all dead now. I examined the trees just before I left home day before yesterday and they are sound; the leaves have not fallen and the trees are not injured. Professor Coquillett told me this morning that his new fumigation is apparently a success; that there is a discovery by which the material can be made a good deal cheaper, so that they can fumigate two trees where they could one before; so that between the resin spraying and the coming parasite and the fumigation we hope to kill not only everything on the orange tree, but also on the lemon. There are two thousand five hundred trees in my orchard. The spraying cost $1,335 17. The material itself cost about one cent per gallon. It can be obtained for two thirds of that by wholesale. The spraying can be done for about two and a half cents per gallon, including the work. The theory of Professor Coquillett was that the scale was killed by suffocation, and gave credit to the resin; that the resin forms a film over the scale and excludes the air, and consequently the scale is choked to death. Now, I thought I only wanted soda enough to saponify the resin and I found that practically four pounds of soda would saponify twenty-five pounds of resin, and do it well, and the caustic properties of the soda were all used up in making that saponification. That was in the sprays I first used. I gave no credit to the soda, because it was all taken up in saponifying the resin. Now, I have changed in that, and decrease the quantity of resin and increase the quantity of soda. I find from my observations that it is better. It gave me the first clean fruit I ever have been able to raise in Tustin, and to-day on my trees I have probably between five and six thousand boxes of as clean fruit as you can see anywhere. It was sold on the trees three months ago when the oranges were not much larger than walnuts, at a dollar a box, though probably I have made a mistake in selling so low.

MR. COQUILLETT: Mr. President, in relation to the hydrocyanic acid gas, Mr. Kellum made a remark that it is almost impossible to kill the red scale on fruit in our experiments. That has been my experience, and that of others; it has been found much easier to destroy them on the leaves and on the twigs than it is on the fruit. The reason for this is not very evident, but we know it to be the case. Hydrocyanic gas is the only treatment that I have ever used that will prove, as I claim, effectual to scale on the fruit and on the leaves; with this it makes no difference where they are. A number of experiments have been made lately at Orange as to a new method of manipulating the machine for producing the gas, so that the cost, as compared with the method heretofore in use, is about one third of what it has been. In treating orange trees about sixteen feet tall by fourteen feet in diameter, the cost of the materal is about 26 cents a tree, and we found, also, that about fifteen minutes confinement of the tree was sufficient to entirely exterminate the scales. Heretofore almost all my experiments have been directed towards the cottony cushion scale, and when two scales were found on the same tree the red scale was much easier destroyed than the cottony cushion, so that by this new method twice the number of trees can be treated in any given time with the gas, and at a cost of about one third of what it has heretofore been. In the present state of affairs it would seem that, even if it is not quite so convenient to treat trees with gas as it is to spray, the results obtained are well worth the additional labor and expense. I am not at present at liberty to make known this new method of manipulating hydrocyanic gas, as it is made under the direction of certain parties and the Department of Agriculture at Washington, but it will soon be made public. In relation to spraying for the red scale, I have made quite a number of tests both with resin, caustic soda, and water, and with resin, fish oil, caustic soda, and water, and the preparation containing a small quantity of fish oil will give better results than when the caustic soda and resin are used alone. Among a number of tests which I made on the red scale the preparation that seems to give the best results was composed of eighteen pounds of resin, five pounds of caustic soda, two and a half pints of fish oil, and water to make a hundred gallons; but this is to be used during the hotter part of the season; during the colder portion it will be necessary to increase the strength; perhaps the materials here given would do for the cooler portions of the year with about eighty gallons of water. In relation to what the Australian ladybug feeds upon, I will say that I have tempted it with a great many kinds of insects, and it confines the attack altogether to the cottony cushion scale. I have shut it up in breeding cages with various kinds of scale—the black, and the soft apricot scale, or the brown apricot scale, and the red scale, and also with a gnat that gets on orange trees—and the ladybug would pay no attention to them. Instead of that they would attack each other. Six of them I placed in a box with the black scale, and at the end of a week they had attacked three of their comrades, and had not disturbed the black scale. The white or the cottony cushion scale is the natural food of the Australian ladybug, and I doubt very much if it would prey upon any other insect whatever.

MR. GEORGE RICE: I would like to ask if the resin spray can be made more effective by increasing the quantity of soda, or by increasing the quantity of resin, or if you find that the combination you have given is just the right thing?

MR. COQUILLETT: There is a considerable difference of opinion as to the manner in which this resin spray destroys the scale; but the theory that it destroys it by excluding the air seems to be the one that is most generally accepted. I have myself seen trees that have been treated with the resin spray with caustic soda in such an amount that it destroys fully five sixths of the leaves on the tree and a good deal of the fruit, and yet some of the scale located upon the fruit escaped. It would appear, therefore, that it is not the caustic soda alone that is the destructive agent in the wash, but rather that resin and the forming of a varnish which excludes the air from the scale. The addition of the oil, of course, would make the varnish more perfect than if the resin alone were used. I have tried the hydrocyanic gas on the San José scale, and it is just as effectual on it as it is on the red scale, and entirely exterminates it.

FLORAL CULTURE.

Essay by MRS. ELLWOOD COOPER, Santa Barbara

California has been and still is reputed the land of flowers, but he who goes through the State to-day finds less upon which to base this reputation than he did when he crossed it in '49, or even as late as '69. Then there were stretches of blue and yellow, red, orange, and purple, covering hill and valley and plain for miles, and as the traveler rode along the country opened before his vision like a great panoramic painting, glorious to look upon.

Since that time sheep and cattle have been increased in such numbers that in their search for pasture they have eaten off and trampled out so much that one of our State botanists told me some years ago that not only individual species, but that whole generas of plants had been destroyed by them. Farmers and fruit growers have plowed up many of the rich valleys, and have tilled the soil so carefully and so nicely that scarcely a wilding flower can have place. Such has been the clearing out of wild flowers by watchful farming at my home, that where there were loads to gather on the foothills in '69, one *now* can scarcely get enough for a bouquet. And *then, too,* there has come to be so great a demand for California bulbs that their places have been searched by collectors to supply the bulb market of other parts. *Lilium humboldti*, that used to make the cañons around Santa Barbara so bright in summer, is now becoming rare, so many of them have been carried away. And most likely the same is the case with *Lilium parryi* and *L. washingtonianum*, these latter being very desirable on account of their rare beauty. A great many of the smaller bulbs, also, must be shipped away, for I see in almost every eastern catalogue California bulbs of various kinds quoted by the dozen.

With the knowledge of all this should not we, *especially* those of us who have rural homes, make some effort to preserve in nooks and corners about our ranches the native flora of our respective localities, bringing the choicest of them into our gardens? Some of them would be quite as decorative around our dwellings and along our drives as many we send so far to obtain.

Among the native shrubs I am now thinking of the various kinds of *Ceanothuses* (the so called California lilac), so lovely in the spring with its feathery violet bloom, set off with dark lustrous foliage; of *Adanostemma*, with its white spray and heath-like appearance; of *Heteromeles arbutifolia*, with its brilliant scarlet berries in the winter, rivaling the English holly; of *Dendromecum rigidum*, the tree poppy with beautiful yellow flowers, which, when discovered here some years since, startled the old botanists by its novelty, as a tree poppy had not before appeared on their lists.

Among vines and climbers I am thinking of two *Clematises* that are beautiful, and that can be made serviceable; of some delicate wild peas; of the beautiful trailing *Pentstemon cordifolia*, and the much famed *Yerba buena*.

Of native herbaceous perennials we have a goodly number. First on the list is *Romneya coulteri*, known as *Matilija*, a beautiful poppy that needs only to be seen to be admired; *Enselia californica*, more desirable for cut flowers than the miniature sunflowers of the catalogues; *Zauschneria californica*, or California fuchsia, and *Silene laciniata*, these two of the most beautiful scarlet, and *Pentstemon azureus*, with its sometimes purple flowers.

Of annuals we have many: poppies, and mimulus, and violas, many beautiful compositæ. Among ferns for decorative planting there is none much more beautiful than our *Woodwardia radicans*, with its great, noble fronds, which, when grown into a fine clump, is a thing of beauty.

All of these are most desirable to bring into our cultivation. Many of them, if not all, are already distributed through the gardens of Europe, and I would remark here, that the kinds I have referred to are those I am familiar with in my own locality. In other parts throughout the State there are many others more interesting and more desirable, perhaps, than what I have mentioned.

In my desire to have our native plants looked after, I do not in the least forget the grand flora of the world that we have to select from; indeed, I think California ought to take the lead in the activity that is now going on in collecting the rare and beautiful things of other countries, which our gardens already have many of, seeing that we have in our State climate and soil suited to the growth of a wider range of vegetable life, perhaps, than any other country of equal extent in the world. Here flourish the eucalypti of Australia and the cedars of Asia, the lilies of Siberia and the crinums of Mexico, the bamboos of India and the tree ferns of New Zealand. In my garden are plants growing and doing well from every country and clime. Our soil is of such quality that some things do better here than where they have always previously been found. I have been told repeatedly by travelers that the eucalypti in California make a much finer appearance than those growing in their native home, Australia; and Professor Hilgard has stated that the English oak has made more rapid growth here than in England. There is a proof of this in the garden of Mrs. White, at Santa Barbara. A young English oak four inches high was set out there in 1886. It is now an erect, vigorous, growing tree twelve feet in height.

There are whole classes of foreign plants that do well here. The aloes, for example, do finely, and can be made useful in producing scenic effects. All the cacti do well, and while not so beautiful as many other plants, they are desirable as interesting objects of study on account of their curious structure and strange manner of growth, many of them having flowers of gorgeous coloring. Every garden should have a collection of these odd looking plants.

Why should we not work with ardor and enthusiasm in planting our State with the beautiful and best of other lands when we can be so well rewarded for our pains? Why should we not extend our efforts from the garden to the drives, from the drives about the ranch to the public roadsides, to the steep hillsides, to the gulches? Seeds scattered and plants set in the ground and cared for until established would become fixed and naturalized. Public roadsides might be improved, and with little expense in this way, by plants which, when established, would take care of themselves. The well known four o'clock, with its various pleasing colors; the chicory plant, with its pretty blue flowers; the graceful bamboo, and many beautiful grasses could be made to take the place of the night shade and nettle, of the clot burr and the foxtail, and the heart of the passer-by be cheered by the sight of pleasant things.

I am often troubled at the havoc and waste made by heavy rains and floods widening the gulches, carrying away the soil from the hillsides and steep slopes, the soil which nature has been making bountifully for so many years, carried off in rivers, and by rivers into the sea, and lost. This great waste could be stopped by planting the hills with shrubs and trees of spreading roots. Unsightly gulches could be covered with creeping plants, such as the Cherokee and McCartney roses, the periwinkles, the caper plant, bamboos, with creeping rootstocks, small willows. *Salix longifolia*, one of our natives, is a beautiful one for this purpose; the hardy passifloras might turn their beauty to account in this way. Of course, some intelligent care and labor must be extended in the beginning of this enterprise, but the country would be so much benefited, and the citizens and all who would look upon it would be happier for the beautiful change in the landscape.

Many little byways could be made picturesque and beautiful by planting our native clematises, English ivies, some of the more robust passifloras, the silk vine, the campridium, and I almost think the southern jasmine could be established in favorable places. *Phormium tenax*, the Esparto grass, both having an important market value, and both interesting and sightly, ought to be planted out in places not utilized by fruit trees. They would soon form clumps if a good start was given.

I would like to add something more about trees. There are so many grand and beautiful species that do so well here, we ought to plant more of them in clumps, or in avenues, or in groves. We may not live to see them in their full grandeur, but future generations will, and it is noble to work for posterity. Our children and our children's children will be grateful for them.

The love of the beautiful is one of the finest emotions of our nature. It arouses within us activities that lead on to high and grand ideals, and nothing awakens and increases this love more than watching and studying the beautiful forms and colors in trees and flowers. Our homes should be surrounded by them. Our children should be trained to notice them and to study them. Every ranch might have its botanical garden of larger or smaller extent. The growing of trees is becoming so general and so important, the welfare of so many depending upon it, that a knowledge of vegetable life in its many stages has come to be one of the essentials to our intelligence, and in no way can it better be obtained than by every day observations and practical study.

VOTE OF THANKS.

On motion of Mr. Husmann, a vote of thanks was tendered to Mrs. Cooper for her essay—a standing vote, in which every person in the Convention arose.

DISCUSSION.

Mr. E. E. Smith: Mr. President, I have listened with a great deal of pleasure to the most excellent paper read by Mrs. Cooper, and while words of mine cannot add additional glory to California flowers, yet I wish to say that I love every tree and flower that makes glad the hillsides and gardens of our State. Is it too much to ask of the delegates present, after the eloquent appeal they have heard, to plant at least one more flower when they go home, through the unfolding leaves and blossoms of which old Mother Earth can smile? True the reckoning cannot be made in pounds like that of fruits which live and perish. What will the harvest of the flowers be? Is it possible to estimate the fame which their perfection has brought to California, or is it possible to count in dollars and cents the good influences which they have thrown around us, the brightness they have brought into our lives, and the good deeds and thoughts of which they have been the inspiration? Mr. President, the brilliancy and sweetness of California flowers are only equaled by the fair beauty of her daughters, the nobility of her sons, and the lusciousness of her fruits.

Mr. Husmann: After such an eloquent appeal I am very reluctant to speak of California floriculture or arbor-culture, but having been a lover of flowers all my life, and having come here, as many of you would say, recently—eight years ago—I was struck more with seeing those plants I had been trying to foster and care for and culture in diminutive life in the East growing so luxuriantly and readily here. When I saw fuchsias growing into trees in the gardens of San Francisco, a climate perhaps better adapted to them than any climate in the world; when I saw geraniums climbing up the walls of houses to their eaves; when I saw growing into trees what had been the admiration of my life in hothouses, I found I had come to a climate which was really the home of flowers and trees, and these are the trees which everybody ought to possess and take care of. Among them are the magnificent sequoias, the Douglas spruce, which has now become one of the forest trees of England; our madrona, our bay tree or mountain laurel, one of the most magnificent trees I have seen anywhere; and among the shrubs are the native rhododendrons, making cheerful all our picturesque glens. I think we ought to follow the ideas thrown out in Mrs. Cooper's admirable essay, and concern ourselves with those trees and flowers which grow with comparatively little labor, and make glad our roads and hillsides by planting them. The love of the beautiful always finds a response, especially in the female heart, and in the hearts of our children if we train them right, and it is a sentiment that should be encouraged and fostered whenever possible.

Mr. Sesheleman: This is a very interesting discussion as to the fruits and flowers and trees to beautify the State, and I do not know that too much can be said on the subject. But I do not think I can add anything to what has already been said. One thought came up with us last night, suggested by our President, Mr. Cooper, as to the proper protection of trees. Now, I can see very well how the railroad might protect a little park at the depot, and how our School Directors might protect the shrubbery around the school house, but I have a ranch out here with four miles of road around it, and I am anxious to go to work and put in trees all around in clumps, and various ways, but what protection have I for those trees? The sheepherder I have seen in the mountains, cuts down lofty trees as high as the ceiling, to feed his sheep on the leaves, and his herds come along and destroy everything we plant along the road. I think a beautiful clump of trees every fifty or sixty yards along the broad highways here would add immensely to the beauty of the country, and I believe I would plant trees in the middle of the road all along in front. We have one large cottonwood tree just out of the city here, under whose shade nearly every team stops, and there is no room to get in. How easy it would be to have clumps of trees along these wide roads and through this country, and what country needs it more? Now, I suppose it might not be out of the line of duty for this association to appoint a committee of some kind to communicate with the Supervisors, as to the highways, or probably to go to the Legislature to secure some protection to the forest trees that we are ready to plant along the highway.

Mr. Rolf C. Bird, of Fresno: I have been anxiously waiting to hear some response to the suggestion to decorate our school grounds, and I do not feel like sitting still and letting that pass without remark. It seems to me that if we want to lay a grand, deep foundation in this line for the coming generation, that there, of all places, is the place to commence: to make our school grounds the garden spots of the State, and then we will implant in the young mind growing up a taste and a love for floral decorations that will bear rich fruit all down the ages. Decorate your school grounds.

Mr. Frank A. Kimball: I believe San Diego County is not behind any county in the State in the decoration of its roads, highways, and streets. We have one tract of land lying south of National City, in the southern part of the county, where we have over fifty miles of streets, and every twenty-five feet on each side of those streets is a forest tree, ornamental tree of some kind, or a palm. In that one tract of land, no man can buy a piece of land except he makes a positive agreement to adorn it with trees and flowers, and no one has bought a piece that is not now being set out to trees and flowers in the finest shape possible. Besides that we have organized a society for the decoration of homes, and nearly every citizen is a member of it. Every member pays $1 annual dues, and a committee is appointed, consisting of thirteen persons, who have the general supervision, and every member agrees to conform to any decision that committee shall make. To go over this tract of land known as Chula Vista, you will see every yard decorated and adorned with flowers, such as you will scarcely find in any other part of the State at the same time. There are places that eighteen months ago were covered with sagebrush, were just barren wastes, that to-day exhibit the finest lawns there are in the State. Of course, we have water supplied from our reservoir, and over seventy miles of mains affording water to every tract of land, covering some fifteen or twenty square miles. And with the water and the disposition to decorate and adorn the place, there is no reason in the world why it should not be done; and I think there are many counties in the State that can take pattern after a large portion of San Diego County. One word further: When I came to the county twenty-two years ago, you might have taken the Lick telescope and gone to the top of San Miguel Mountain, four thousand feet high, and you would have seen only my house and the lighthouse. I planted different trees in the yard where I at that time built my house, and I have now a Monterey cypress that measures in circumference over ninety-seven inches, which was then not more than four inches high; its branches extend over sixty feet, just high enough to drive the carriage under.

There is no reason why everybody should not plant trees around their homes. They may be fruit-bearing trees; take the orange, the lemon, or the olive, they are nice shade trees. The olive can be trimmed into any shape it may be desired, even like an umbrella, and the foliage is perfect all the year round; and the contrast between the olive and the orange, as the President well knows, is one of the most beautiful known in nature, and when planted together they will be an addition to any place.

THE RAISIN GRAPE.

Essay by T C. WHITF, Fresno

MR. PRESIDENT, LADIES, AND GENTLEMEN: The subject assigned me for consideration, and to which I invite your attention, is "The Raisin Grape." While I do not expect to add to the information of many who have been long engaged in the business, still there may be some to whom the results of our experience may be interesting, if not profitable.

Ten years ago I was among those seeking knowledge, and found a most efficient teacher in R. B. Blowers, Esq., who kindly gave me the benefit of his experience in the then comparatively new field of raisin grape culture.

The success achieved in the past few years has outgrown a local interest, and is now attracting a world-wide attention. The following table shows the growth of the industry:

	Boxes.		Boxes.
1873	6,000	1880	75,000
1874	9,000	1881	90,000
1875	11,000	1882	115,000
1876	19,000	1883	140,000
1877	32,000	1884	175,000
1878	48,000	1885	500,000
1879	65,000	1886	703,000

In 1873 the raisin crop of the State was estimated at six thousand boxes, swelling to the comparatively enormous number of eight hundred thousand boxes in 1887, and may reasonably be expected to reach one million boxes the coming year.

It has been demonstrated, beyond question, that the soil and climate of portions of this State will produce a grape equal, in size and quality, to those of the most favored districts of Europe.

Permit me to make a few general remarks in reference to the soil, climate, culture, and varieties to be grown, and the best manner to pick, dry, sort, and pack raisins for market.

In geographical distribution, the yield is divided between the great San Joaquin Valley and Southern California. No raisins are produced in any quantity outside of those two regions. The crop of the valley amounts to five hundred and five thousand boxes; that of the southern counties—Los Angeles, San Bernardino, and San Diego—to two hundred and ninety-five thousand boxes. Fresno takes the lead, with three hundred and fifty thousand boxes, nearly double the yield of any other district, and nearly as much as that of all the rest of the State combined. Riverside comes next, with one hundred and eighty thousand boxes.

While I have visited the raisin-producing sections of the State, north and south, my remarks are based upon the experience gained during the last few years in Fresno, in the San Joaquin Valley.

The following requisites are indispensable to the successful production of good raisins: soil, climate, and methods of packing and curing. First, a selection of location with reference to soil.

This, in my judgment, is either the white ash or the red, sandy loam. If your "lines be cast" in the San Joaquin Valley, which I believe to be the best for this industry, be certain to obtain land which can be conveniently irrigated. My own choice would be white ash, if not too strongly impregnated with alkali.

So far as I am informed the first raisin grape cuttings were imported by the elder Haraszthy in 1862. These were the Muscatel Gordo Blanco. Later, there were other importations, which were sent to different portions of the State, and assumed the names of Muscat and Muscat of Alexandria, causing much diversity of opinion in reference to identity and respective merit. "When doctors disagree, who shall decide?"

My vineyard is exclusively Muscatel Gordo Blanco, which I consider the best on account of its uniform large size of berry throughout the entire cluster, small size and number of seeds, tender skin, richness of pulp, and high flavor.

The vines should be trained low and pruned short, and great care and judgment should be exercised in this matter, so as to leave the vine well balanced; not having more spurs on one side than the other, and also leaving top spurs, with a view to growing wood for shade.

Another important consideration is the removal of all suckers and non-fruit-producing growth, to avoid the diversion of the strength and vigor of the vine from the fruit and growth of wood for the succeeding year.

The vineyard should be plowed and cross-plowed, as soon as the vegetation starts in spring, and cultivated thereafter continuously until prevented by the growth of the vines.

Much can be done toward destroying the vine-hopper by thoroughly stirring and displacing the soil immediately around the vine early in the season. To assist in accomplishing this, plow away from the vine, then shovel directly around it, and then cross-plow, turning the furrow toward the vine.

Another important aid in destroying this pest, is sulphuring; which should be commenced as soon as the vine has put forth a new growth of one or two inches. Just before blooming, sulphur a second time, and in localities liable to mildew, a third application may be beneficial. Couleur, or the blasting or dropping of the bloom, is probably caused by sudden changes of temperature, strong winds, and excessive moisture. When caused by the latter, it can be largely overcome by the application of sulphur. As vines become older I think they are less susceptible to climatic influences. Irrigation at the blooming period should be avoided, and until the berry is well set.

If summer irrigation is necessary, it should be done by means of furrows, through which the water is run. Plowing in these furrows will prevent the cracking and drying out of the land.

In Fresno picking commences about the first of September, although there have been seasons when it occurred as early as the twentieth of August.

The grapes under no circumstances should be picked for raisins until they are ripe. There are three ways by which to ascertain this fact: First, by the color, which should be a light amber; second, by the taste; and third, by the saccharometer, which is by far the most accurate. A grape may be ripe and not have the proper color, when grown entirely in the shade.

The juice of the grape should contain at least 25 per cent saccharine, to produce a good raisin.

The most practical method of drying is by the use of trays placed upon the ground. The almost entire absence of dew in our locality greatly facilitates this method. The trays are usually twenty-four by thirty-six inches. Those of larger dimensions are found inconvenient to handle when filled. Trays of the former size hold about twenty pounds of fruit, and should produce from six to seven pounds of raisins.

The product of a vineyard depends largely upon its age and favorable conditions, varying from two to nine tons per acre.

The trays or platforms are taken into the field and distributed along the sides of the roads, from which they are taken by the pickers as they are needed. As the grapes are picked from the vines, all imperfect berries, sticks, and dead leaves are removed from the bunches, which are then placed upon the trays, right side up. A cluster has what is called a right and a wrong side, the wrong side having more of the stems exposed than the right side. Great care should be used in picking, so as to handle the bunches only by the stem. If the berries come in contact with the hands, some of the bloom will be removed, which will injure the appearance of the raisin.

The trays are placed, after filling, between the vines, one end being elevated so that the grapes may receive the more direct rays of the sun.

The length of time required for drying depends much upon location and conditions, favorable or otherwise. I have known raisins to be dried in seven days, but they were not a good article, and too rapid drying is not desirable.

The grapes are left upon the trays until about two thirds dry, which, with us, will be in from six to eight days. They are then turned. This is accomplished by placing an empty tray on top of the one filled with partially dried raisins, and turning them both over. Then take off the upper or original tray, and you have the raisins turned without handling or damage. After turning, curing will proceed more rapidly, and frequently is completed in four or five days.

During this time they should be carefully watched to prevent any from becoming too dry. When it is found they are dry enough, the trays are gathered and stacked one upon the other as high as convenient for the sorting which follows. This protects them from the sun and prevents overdrying. Stacking should be attended to early in the morning, while the stems and berries are slightly moist and cool from the night air, as they will retain this moisture after being transferred to the sweat-boxes, and assist in quickening the sweating process.

The trays which have been stacked are now ready for sorting and grading, and this requires care and judgment, and although a tedious process, greatly facilitates rapid packing.

The sweat-box is a little larger than the tray and about eight inches deep. When filled these will contain about one hundred and twenty-five pounds of raisins. Heavy manilla paper is used in the boxes; one being placed in the bottom, and three or four more at equal distances, as the filling progresses. The object of the paper is to prevent the tangling of the stems and consequent breaking of the bunches when removed for packing.

The sorters have three sweat-boxes; one for first, second, and third qualities, as the grade will justify. The bunches should be handled by the stem, and placed carefully in the sweat-boxes to avoid breaking the stems, thereby destroying the symmetry of the clusters.

Any found to be too damp are returned to the trays and left a day or two longer in the sun. To ascertain if they are perfectly cured, take a raisin between the thumb and forefinger and roll it gently until softened, when either jelly or water will exude from the stem end—if water, it requires further drying. When the boxes are filled they are taken to the equalizer. This should be built of brick or adobe, and as near air-tight as possible, but provided with windows, to allow ventilation when necessary. The windows should have shutters to keep it dark. The filled boxes are placed one exactly upon another to a convenient height, and should remain from ten to twenty days or more, when they will have passed through the sweating process.

As the raisins are taken off the trays, some of the berries on the bunches will be dry enough, and a few will not be sufficiently cured. To remove the moist ones would destroy the appearance of the cluster, and to leave it out longer would shrivel the dry ones, hence the sweat-box. The moisture is diffused through the box, some being absorbed by the dry raisins, and the stems also taking their share, and are thus rendered tough and pliable and easily manipulated when ready for packing.

When the raisins are sufficiently equalized, the sweat-boxes are removed to the packing room, which is provided with tables, presses, scales, etc.

My method of packing is substantially the Blowers style—face downward.

The most convenient mode of packing is by the use of a metal tray corresponding in size to a layer of raisins and having a loose bottom. The raisins are placed in the preliminary packing tray, with the face of the cluster downward, which gives the surface a level appearance, and prevents the exposure of the stems. When the bottom of the packing tray has been covered, which should always be with perfectly shaped berries and bunches, the tray is filled to the requisite weight of five pounds. The contents of the tray are then pressed sufficiently to pack the raisins firmly together, but not with such force as to break the skin, causing the jelly to exude and consequent early sugaring.

After being pressed, they are transferred to the boxes, during which process the paper is wrapped around each layer. The paper is placed on the top of the tray of raisins, and a sheet of steel, the exact width of the tray, is placed above the paper, and the whole reversed. The sheet of steel serves to hold the raisins in place until the layer is put into the box, when the steel is withdrawn and the layer drops into the box face up.

The standard box of California raisins is twenty pounds weight, containing four layers of five pounds each. They are usually graded into Dehesia and London layers, layers, and one, two, and three crown loose muscatels.

The Dehesia, or highest grade, is packed with a view to superseding the imported article, which sells at from $10 to $12 per box.

Every one has seen and admired the boxes of imported raisins which have a top layer packed in rows, with uniform regularity; few, however, appreciate the difficulty of producing this handsome appearance by hand. The task is slow and tedious. To simplify and expedite the process, I have invented and received letters patent for a packing plate, expressly adapted to producing this effect. This device will prove of great assistance to the raisin packer. I have used it through two seasons with perfect success. The invention consists of a flat, metal mold, or plate, having depressions made in its surface, which plate forms the bottom of the preliminary packing box, and serves to hold the raisins in a fixed position until the packing is completed and the raisins are placed in the raisin box. Loose muscatels are prepared by being put through the stemmer and grader. The stemmer removes the berries from the stems, and the grader, by separating according to size, determines the grade.

By observing the foregoing remarks, you will naturally conclude that the raisin business is eminently made up of details. None can be carelessly performed or overlooked, if we expect to compete successfully with the nations who have made this subject and industry a study for centuries. Not only in the essentials of quality and quantity, but in this esthetic age a due regard to effect must be observed in the way of attractive wrappers and labels.

The industry with us is in its infancy comparatively, and while we have some cause for congratulation, still we have much to learn before we attain perfection. In reference to shipping, it is to be hoped that the near future may bring us better facilities and cheaper rates of freight, thereby enabling us to supply the eastern market and the growing foreign demand. I note by late quotations that all grades of raisins are scarce in the home market, and insufficient to meet the demand until the next crop. May this be an incentive to us to increase and extend the industry through the length and breadth of our inland valleys.

Much may be accomplished by a free interchange of ideas and comparison of notes in reference to methods and results. Local and State Conventions afford good opportunities for such conferences.

MYSTERIOUS VINE DISEASE.

DISCUSSION.

Mr. Tim. Carroll, of Anaheim: About 1883 I first noticed a vine here and there, perhaps one in every acre, that did not look well; we laid it to the alkali. In 1884 it seemed that the alkali was taking more of them, so then we laid it to a fungus. We didn't know what it was. We thought it was a mildew, so that year we sulphured our vines, some of them three times, but that didn't stop it. In 1885 the vines made a good growth on those that were alive, and we were expecting to have a bigger crop than we ever had before; but after the berries got to be about half grown they began to wilt, and the leaves began to curl up, and they dried, and the vines turned yellow, and they dried green, and the tops of the vines wilted down; they were dry about three inches—that is, the tips of the vines. We pruned our vines that year, and it seemed that the vines close to the trunk were fresh and healthy, but the next spring the most of the vines died out when fruit should begin to set. They seemed to die from the top down. I wanted to find out what was the matter, and dug up a quantity of dead vines, and took one, commenced at the top and cut it in pieces and split it up. I found the top of the vine completely dead; a little lower down there was a little life, but where the roots come out just below the ground it was full of sap. I followed the roots down about five feet and examined them, and the sap flowed just as free as in a healthy vine which I dug up and examined in the same way. I could see no difference in the flow of sap nor in the color. The disease has taken the whole of the vines. It is not alkali, because that is easy to discern. With alkali, first the roots and then the top goes; but in this disease it dies from the top down. Mr. Langenbetger's is on sandy soil, and I believe you could turn the Santa Ana River into it and in twenty-four hours you would not see a drop of surface water on that land. It is twenty-five or thirty feet deep. I don't think it is the alkali that had any effect on it. The vines in and around where they first thought that the alkali had any effect, are the only vines that they have in Anaheim from which to make wine to-day.

FRUIT CULTURE IN FRESNO COUNTY.

By George E. Freeman, Fresno.

Had one, twenty years ago, spoken of Fresno County as a most promising fruit district, he would have been considered a fit subject for an insane asylum. Then a vast arid desert the most of the year, its lands were considered as next to worthless, except for wandering flocks to graze upon; no one supposed that water could ever be secured for irrigating this wide-reaching plain, or would be of any use if secured. One of our now wealthy citizens offered at that time to eat all the fruit a man could ever raise by irrigation.

But time works surprising changes; irrigation has been tried, and with results that have surprised even the most sanguine, converting already many thousands of acres of the once dreary, almost worthless desert into a rich and most productive garden.

The arable lands of the plains of Fresno consist of somewhat over a million of acres. To this we may add many more thousands of acres of sheltered valley amid the foothills on either side of the plain, both east and west, affording some of the choicest and richest locations, especially adapted for fruit culture, that can be found in the State.

The experiment of irrigation in this county has now been in practice about fifteen years. As a result we have now nearly one thousand miles of public irrigating canals, coursing through the valley from east to west in many divergent lines, and covering, or capable of covering, with sufficient water for cultivating, not less than one hundred thousand acres of land. The great body of this land has been found particularly adapted to orchards and vineyards. Our soil is almost uniformly a rich sandy or alluvial loam, quite porous, and usually highly impregnated with phosphates and vegetable mold.

A special peculiarity of much of the soil of this county is its natural adaptability to sub-irrigation. The under lying water, fifteen years ago, was forty or fifty feet below the surface. Now, from the result of seepage, it can be reached at from five to fifteen feet. This sub-irrigation is not stagnant water in the soil; it has its current underground no less than the flow of the ditches on the top, although of course not so rapid, and it thus increases each year, pressing out upon the plains and filling the depth of the soil far in advance of the irrigating canals. This valley has an almost uniform slope, from the foothills to its center, of from five to six feet to the one hundred feet, forming a most perfect trend for waterways, thus enabling us to establish the cheapest and most successful system of irrigation. It is this slope also that aids to press the sub-irrigation down into the center of the valley and over its broad extent. This gentle, gradual slope answers also another important end. It might be feared that this gradual filling up of the soil from beneath would continually come so near the surface as to make the whole region a vast swamp. But this is prevented by the natural drainage which this slope secures. The waters of Kings River, brought upon these plains from the foothills of the Sierras, are in a large part in the form of sub-irrigation, pressing through many miles of underground flow, to reach again their old channel in the center of the valley; and if at any time, in depressions, this sub-irrigation should come too near the surface, we have every facility to introduce a drainage system, at a small cost, to send the surplus on its benevolent errand of making fruitful the regions beyond.

The establishment of such a vast irrigation system in this region has largely advanced the culture of grains and grasses. The growth of alfalfa is with us an immense and most successful industry; but the chief development has been in fruit culture, which is destined to be the great industry of this valley and of the State.

Within the past few years comparatively few trees have been planted, and not a few in their full vigor and productiveness have been cut down to make room for what is considered the more remunerative business of raisin culture. These orchards are composed of almost every conceivable kind of fruits, all of which grow here with great productiveness. Yet, like many other regions, ours has its special adaptations and specific fruits that can be raised with the greatest profit. Among the most profitable orchard fruits may be named the peach and nectarine, and the apricot in some localities. These are of very rapid and healthy growth, coming into bearing in the third and fourth year, and with the assistance of our summer climate for sun drying, give large returns from the crop.

Apricots and peaches both do well, but so far we have to dry our fruit to send it to market. Our dried fruit has brought good prices. We have here, as in all other localities during the past few years, to fight the San José scale, which increases expenses and diminishes profits. Pears and plums grow and bear well, but have not yet proved in general a paying product. This is largely because of the disadvantage we yet rest under in the matter of shipping both green and canned fruit, the freight rate being considerable in excess of almost all the fruit centers in the State.

The result of prune culture has not, I think, been sufficiently promising to regard this as a hopeful industry in the future. The question is not simply what you can grow on your land, but what will give the most profitable return. Which, peaches, plums, apples, grapes, oranges, potatoes, cabbages, onions, or beans? This, however, is to be said: we have yet vast areas of arable lands in the foothills, rich and choice valleys, where almost all our orchard fruits that require cool, moist atmosphere, can be grown.

Olive culture is yet in its infancy in this county. We have only a few trees six years old, but these older trees have grown well and bear heavily. Within the last two or three years considerable acreage has been set to this fruit, and the prospect for future success is good. The same is true of fig culture. The black California fig is an old habitat of this county, and has been a sturdy grower and most prolific bearer. This can be seen in the older foothill towns of the county. Within a few years attention has been turned somewhat to fig culture, and many acres have been set out. So far the result is very promising. The variety most in favor is the White Adriatic. This year one large shipment has been made East, and, I understand, with the most satisfactory results.

We have as yet given very little attention to the culture of citrus fruits. A few orange orchards in the foothill regions of this county, fifteen or eighteen years of age, show excellent results, probably not exceeded by any like number of trees in the State. Their fruit is ripened among the very earliest. The black scale which troubles citrus trees in so many other places does not seem to be able to live in this county. Within the past few years much more attention has been given to orange culture.

The cultivation of the fruits so far referred to may be called only the side issues of Fresno County fruit culture. This valley, under the "reign of water," is remarkably adapted to the culture of grapes of all varieties. Thus the planting of vineyards became our leading industry. At first this was largely confined to the culture of wine grapes, and several of the largest vineyards and wineries in the State have become established and are now famous the world over, and with results no less satisfactory than those of our best wine districts. The yearly output of wine and brandy has been during the last few years in the region of two and a half to three million gallons. The heavy bearing quality of many of our wine grapes is here phenomenal, reaching in our best vineyards twelve to fourteen tons to the acre.

But in the planting of vines, attention was soon turned to the Muscat or raisin grape. Early experiments proved that our rich alluvial soil was eminently fitted to the growth of this superior grape, and our climate was equally suited to the cheap and easy curing of the fruit as those foreign countries which produce the delicious raisins of the world's commerce. This industry had many obstacles to overcome in the beginning, many predictions of failure, and many sneers over the early product. The raisin output was about four thousand twenty-pound boxes seven years ago, and it must be confessed was, upon the whole, not an article likely to win renown in competition with the well established foreign brands. Not a few raisin-grape growers were so discouraged as to contemplate cutting out their Muscat vines. I recall an instance where an owner of a forty-acre vineyard in one of our colonies resolved to "clean the whole thing out," and was prevented only by the pleading of his wife: "Spare it one year more." Since then that very man has sold in one year nearly $6,000 worth of raisins from this vineyard. And this case but indicates the change that has come to this entire district in regard to the raisin culture. Now, instead of cutting out raisin vines for other products, orchards and wine vineyards are dug up to make room for larger areas of this promising industry.

At present, our raisin vineyards may be estimated at from fifteen to eighteen thousand acres, of which from ten to twelve thousand are in more or less of a bearing condition. Our wine vineyards embrace about five or six thousand acres, making a total acreage not much short of twenty-three to twenty-five thousand acres. This acreage was largely increased last year, and promises to be still more largely increased the coming season.

The increase of product has gone forward from four thousand twenty-pound boxes in 1882, to a product of about five hundred and fifty thousand boxes this year. At the present rate of planting, it will only be four or five years until at least between two million and three million boxes will be put up in the Fresno district.

Still, I would add, that what is about to be achieved in this county is also possible in many of the other counties comprised in the San Joaquin Valley. If the same distribution of water, and skillful devotion to the raisin industry is given, a great extent of this vast valley may in time become a grand area of raisin vineyards.

This Muscat vine is a rank feeder, and finds abundant food in the multitudes of old sloughs and extinct waterways that course through this valley. It loves abundant moisture, even up to the ripening of its fruit; this it finds in our prevailing sub-irrigation, and in many cases obviates all necessity for surface irrigation. A few of our very best bearing vineyards have never had any surface irrigation. With this permanent underground moisture to draw from, makes it possible to harvest a second crop of grapes, in quantity and quality nearly equal the first one.

The fervid sun gives us the cheapest and best evaporator that has ever been invented; in fact the only one that can make a raisin of the highest quality. With the exception of the present anomalous rainy October there has not been a season since the raisin business began here that our crop has not been secured from beginning to end in first class order. The few driers that have been built standing as matters of convenience rather than of necessity.

Fresno is to-day proud of her raisin industry. We do not keep this matter "hid under a bushel." We are raisin enthusiasts all through, as doubtless some others of you are on oranges, prunes, nuts, beans, or potatoes.

California is destined to be a region of specialties; every district may be able to raise with more or less success all the products of all the others, but almost every district can raise some one commodity better and with larger profits than any other district. Now, it is the largest profit we are all after. How wise will it be for us to study carefully what specific industry we can follow with best results, and then build up our center about this. We might here in Fresno spend a vast amount of time and money in trying to raise some classes of fruits, when there is scarcely a shadow of a chance that we can compete with some other district. We have already spent too much time and money in this line, and not a few other districts are, I think, doing the same foolish thing.

We expect in another year to have a raisin exchange established here in Fresno, where, instead of going out to hunt buyers, they will come here and buy directly from the producers.

Fresno County so far in its history of fruit culture has been the phenomenon of this Pacific slope. The magnitude of its possibilities in this line can scarcely be imagined to-day, and a kind Providence, preventing any setbacks, will enable us in a few years to double and quadruple the present product.

DISCUSSION.

Mr. Motheral: Have you any hardpan coming near the surface?

Mr. Freeman: In some places the hardpan comes up quite near to the surface. I think I remember of a spot where they struck the hardpan between two and three feet, but anywhere it comes within about seven feet. Mr. Butler, during the last season, has been all through the raisin districts of Spain and examined them carefully. In the Malaga district he finds that the land is of a quality that does not sub-irrigate; even at the present time you have to go twenty or twenty-five feet or more down to water. In that region where there is a great deal of surface irrigation, the vines are dying very much as they are in the south, but in the Valencia district where sub-irrigation comes within four or five feet of the surface, just as it does in this valley, the vines are to-day as healthy as they were eighty years ago. His theory is that our conditions here of sub-irrigation will protect us from any such disease.

Mr. Aiken: I want to ask Mr. Freeman whether the trees upon lands where the water nearly reaches the surface and where the roots reach to the water, live and do well?

Mr. Freeman: My orchard grows on that kind of land, and I have as nice an orchard as there is in Fresno County. The trees never have been irrigated, but simply watered by sub-irrigation. I do not think though that they would be as long lived on that account as orchards would be on different land.

Mr. Johnson: Going through a neighbor's orchard last summer, I saw quite a spot, probably half an acre, of his trees that were turning yellow. They were loaded with fruit, but the leaves were as yellow as gold, and I was naturally curious to know what was the matter with those trees, and took a shovel and went out and dug down about eighteen inches and struck the hardpan, and on the hardpan about four inches of water. I went to two or three places with the same result, and came to the conclusion that it was too much water. His place adjoins mine, and I have some of those vines that shed their leaves as has been discussed. I found the same thing where the vines had shed their leaves and the fruit withered up. Last summer by digging six feet we struck water, but water in that well now is sixteen feet from the surface. We have had no water in the ditches since the first of July. I have come to the conclusion that to save that affected part of the vineyard, all I have to do is to break this hardpan—it is not over two inches thick—to break it with a crowbar or something of that kind, for say four feet, and I think I can reclaim that land. There is much alkali in those spots.

Mr. Freeman: There is a point in regard to the water affecting the trees here that I think ought to be noticed. I stated in my essay that where there is sub-irrigation there is no stagnant water. It is a very important matter that the sub-irrigation has its current as much as its streams. I have a well, and when my neighbor half a mile away irrigates his alfalfa the water in my well rises, and this is constant running water; it is not stagnant water. If you set your trees out where there is stagnant water underneath, I think they will die.

Mr. Kells: I will say, Mr. President, in regard to the old Briggs orchard, that, as many of you know, being on the bank of the Feather River, near Yuba City, the ground was covered with debris from the mountains, from mining, to the depth of from three to ten feet; in many places the cherry and the pear trees, and what is known as the Briggs May peach, have been covered with sand up into the crotches of the trees, and in the early times, you know, they pruned their trees very high; yet to-day some of those Briggs May peaches are bearing good, nice-looking fruit. Of course, we think that the fruit is somewhat insipid from the fact that there is so much moisture, but the idea of the moisture killing the tree has been abandoned from the minds of most of our people. They think that it is not moisture that will kill or sour the roots so that the tree will die, but old age or scale, backed by some other causes. Two years ago last February, in many sections of the country, we had a warm spell of weather, and the fruit trees started out rather earlier than usual, and, as we had had rather over an average amount of rain in the winter, the ground was full of moisture. In the last days of the month the weather suddenly cooled, and some of our young orchards began to have the appearance of the vine disease I hear described here. The ends of the limbs and the leaves began to wilt. The limbs began to droop and to die back, and within a month's time a number of our trees, perhaps a dozen in a place, would be dead. On passing through the orchard we noticed a peculiar smell and supposed it was root rot of some kind. After examining a few we decided that the sap had begun to flow, and the cold spell had come on and stagnated the sap, and it had no chance to flow, and soured.

Mr. Block: I would suggest for the benefit of this Convention, and also of those who are interested in raisins, that these propositions as to how much is realized, had better be made in executive session, because if it comes to the ears of the railroad company, instead of $1 40 the rate would be $2 40.

Mr. Freeman: In answer to the question as to the distance apart that vines should be planted, there are various methods used in regard to planting so far as distance is concerned. Most of the early vineyards were eight by eight feet; after that a change was made in regard to raisin grapes, and they were planted almost in every instance ten by ten feet. Now I think the prevailing system is about eight by ten feet, and that seems to be about as good a distance as we can hit upon; ten by ten feet uses more space than is necessary, although doubtless in the future years, the vines exhausting the soil, that distance may be as good as the other. Some vineyards are planted ten or twelve feet one way and five or six feet the other; a vineyard near here is planted that way, and the yield was very great indeed; and I think the understanding is that perhaps in a few years they will be able to cut out every other vine in the closely planted rows, and thus leave them ten by twelve feet, or ten by ten feet. The last vines that I planted out are eight by ten feet, and if I were going to plant a thousand acres this year I should plant them all in that way.

Mr. White: When I planted my vineyards there was no raisin vineyard in Fresno County, and I could get no information from anybody, and planted mine the same as Mr. Blowers planted his, eight by eight feet. I have had very good results, and I don't know as I have any reason to find fault with it; but I believe if I should plant another vineyard now, I should plant the vines six by twelve feet. I would plant the rows running east and west twelve feet apart, and the rows north and south six feet apart. A vineyard planted thus can be cultivated with less money, and the grapes can be more easily gathered. A team can be driven between the rows and leave plenty of space for drying, placing the trays along on the south side of the row, so the next row of grapes on the south side does not cast a shadow on the grapes while they are drying. That is one advantage, and then I think twelve feet square is plenty of space for a vine. Every twenty or thirty rods a row may be left out for a crossroad. We plant rooted cuttings now entirely. Cuttings planted out in a vineyard will not grow. I can give you no reason why they do not live as well now planted in the vineyards as they used to. When I planted my first vineyard I had a good stand of vines, planting entirely cuttings; but I have seen cuttings planted out recently where not 5 per cent lived. I would advise to plant nothing but rooted vines, and get a big root.

Mr. Aiken: Might not that have been the fault of the planter?

Mr. White: No, sir; planted by the very best men, with the best of care. I think it would be advisable *always* to plant rooted vines, and yearling roots are better than two-year old.

Mr. Carroll: I will explain about the cuttings: It seems by what these gentlemen said to-day that the water is nearer the surface now than it was some years ago; and by planting a cutting—that is, if it is too long—when you put it down into the cool ground it commences to rot at the bottom, and, therefore, it will not grow; but if you take a cutting with about two eyes, leave one above and put the other down below; I think there will be no trouble in getting them to grow. We found down in our country where the ground was cold, we had to use short cuttings; very short, because, if too long they would rot. I would like to say a word as to the nature of the soil that this vine disease started in, at Anaheim, and the distance to water from surface. The disease started first in the best soil we have there—the black, sandy loam; I think it is about ten to twelve feet in depth, with under-drainage of sand and white sand underneath, and the water is about twenty-five feet below the surface. There is no stagnant water where it started first; as to the richness of it, that soil will grow from forty-five to fifty bushels of corn to the acre, and that shows that the land is not so poor that it could not support the vine. That amount of corn has been raised since the vines are dead. They began to die in heavy soil, and the fatality extended to the higher, light, sandy soil.

A Delegate: Did the disease start in Mr. Landenberger's vineyard?

Mr. Carroll: No; it started in Mr. Dryfus' vineyard, on the west of Anaheim; Mr. Landenberger's is on the north. I think it was very near a mile from where it was stated to-day that it started. I have lived there for twenty-two years, and know all about it. It started in 1883, and you would see in about every acre, or perhaps two acres, a vine about July or August that would look kind of sick; we all thought, perhaps, that it was the alkali effect, but we found out that it was not. The next year, in 1884, there seemed to be a great many more dying, and in 1885 almost half of the vines were gone, and in 1886 they cleaned the whole business out. There was not a vine to be seen; there are no vines in that part of the country.

Mr. Aiken: In many portions of the State, around the Bay of San Francisco especially, rooted vines are not used very much; they find the cutting in the fourth year will overtake and surpass the rooted vine. In the disturbing of the rooted vine by removal, many of the roots are destroyed and the equilibrium between the roots and the top is somewhat affected and it does not start so readily as a cutting, which in the second, third, and fourth years makes a very pretty growth.

THE LATE MATTHEW COOKE.

On motion, the committee appointed at the last Convention as to the matter of procuring a tomb for the late Matthew Cooke, is granted further time in which to make a report.

COMMITTEE ON MEMORIAL TO CONGRESS.

On motion of Mr. Buck, it is ordered that a committee of three be appointed by the Chair, to draft a memorial to the United States Congress in reference to sending an expert to find predaceous insects. The Chair appointed as such committee, W. H. Aiken, L. W. Buck, and R. C. Kells.

RAILROAD RATES.

Mr. Buck: One of the most important matters that the fruit industry of this State should impress upon, not only the Southern Pacific system, but their connecting lines East, is the building and furnishing of fruit cars. Any person who has had experience in the past two years, knows very well that there have been times when it was an impossibility to get suitable cars in which to ship fruit East. The railroad company claim they have so many fruit cars already, but they do not add that they ship tea and baggage in their fruit cars, and that they are continually in use. There are a great many fruit cars that we never see on the coast. A committee should be selected from this Convention, who will not be on like committees of other organizations, to press this matter. The California Fruit Union has always done all it could to secure a lower rate of freight and additional fruit service; so also have the State Board of Trade and the Chamber of Commerce of San Francisco. I therefore move that a committee of three be appointed by the Chair, to confer with like committees of other bodies, to present the matter of building and furnishing cars to at all times meet the requirements of fruit and other shippers, and also to demand lower rates.

Adopted.

Committee: R. C. Kells, Yuba City; H. E. Parker, Penryn; L. M. Holt, Riverside.

NEXT PLACE OF MEETING.

The following communication was received and read:

Los Angeles, Cal., November 2, 1889.

Gentlemen: The Citrus Fair for the Sixth Congressional District is to be held in this city from the tenth to the fifteenth of March, inclusive, 1890.

By direction of the Board of Directors of this Chamber, at a meeting held this day, the Secretary was instructed to extend to you an invitation to hold your spring meeting in this city during the week of the Citrus Fair in March next. At that time you will have assembled here the entire fruit-growing population of Southern California, and the more prominent fruit growers of the whole State. The exhibit will be of such a character as to make it profitable to each and every member of your Convention to make a practical study of citrus and semi-tropic fruits. Our Board extend to you the free use of our hall for your meetings, and will guarantee that all courtesies usually extended by the various places to induce the holding of these meetings will be most cordially extended by our citizens to you at that time, and your visit made both pleasant and profitable.

Under the circumstances, we think it the proper time and place for your spring meeting.

By order of the Board.

M. R. HIGGINS,
Secretary Chamber Commerce.

Milton Thomas, of Los Angeles, offered the following resolution, which was seconded by Frank A. Kimball and Geo. Rice. Said resolution was adopted by an enthusiastic and unanimous vote:

Whereas, The City of Los Angeles, through its Chamber of Commerce, and by her citizens in attendance at this Convention, have made an earnest appeal, requesting that the next Convention of this body be held in that city; that the time of holding said meeting be during the week of the State Citrus Fair in that city; therefore, be it

Resolved, That the State Board of Horticulture be requested to accept the invitation, time, and place, with due appreciation of the courtesy.

OLIVES AND CITRUS FRUITS.

DISCUSSION.

Mr. Cooper: I will state, for the benefit of all parties interested in olive growing, that the subject was very fully discussed at Santa Rosa, Santa Barbara, Chico, and National City, as shown in the printed books that are here before you: the biennial reports of 1887 and 1888, the transactions of the Chico Convention, and the transactions of the Convention held at National City, both on olive culture and citrus fruits. There has been some uneasiness as to the planting of olives in Fresno County. An old neighbor of mine in Santa Barbara, who is living some twenty miles from here, sent in some branches from an olive tree four years old, with the first fruit, and from the appearance and growth of the limbs, the size and perfection of the fruit, I should think there is little doubt as to olive growing in Fresno County. I also visited the Fresno Vineyard, containing quite a number of olive trees four, five, or six years old—the only olive trees I have seen since I have been here—and some of them are very well fruited for young trees; not so loaded as they are in Southern California, but what I would call, for a large orchard of the average size of the trees, very well fruited with very fine fruit, entirely free from insect pests.

Mr. Lelong: I do not wish to take up the time of this Convention, for I had much rather hear some one else talk than to be heard myself, but a word on this olive question. I think I have discovered the true method of curing the olive, green. I do not think there is any one in this State that has accomplished it before. I am speaking of the green olive; I have no reference to the ripe. What I mean is that no olives, so far as I have seen pickled green, have retained their color without injury; most of the olives I have seen pickled green, in time turn to a dull yellow color. I tried a great many experiments last year, accomplishing a little, and that helped me out this year. I have tried all the foreign processes I read about, and I find they are all misleading. There is no foreign process published, that I know of, that can be used, although they aid us in experimenting. The following foreign process was sent to me by one of our European Consuls: To three pounds of ashes and six ounces of lime, add six quarts of water; these are boiled together and after the ashes had settled the lye rose to the top; this lye was added to the olives, which have been picked with a great deal of care to prevent bruises. I found that this process, while it did cure the olives, retaining the color without injury, was one that no one could use, because after boiling the mixture—you must boil it at least twenty minutes—you will have about two pints of lye, the balance is like a lot of mud which you have to throw away, making it troublesome and expensive. I experimented then in various ways to obtain the same ingredients through chemicals, and after experimenting a great deal I found that by taking eight ounces of chemically pure potash—not the potash that you use on your trees—it must be chemically pure (sold in ten-pound tins at 15 cents a pound). This potash is different from the other; it is less corrosive. It must be used chemically pure; the others contain ingredients that are detrimental to the olive. To this I add six ounces of lime. The lime is put in a little water and slacked; after it is entirely dissolved the potash is added, and water is put in and boiled. It is then put in a barrel and left to cool, and as it cools the lime will settle to the bottom and the liquid will be white. It is then put on to the olive, and the olives are stirred about every three or four hours; they are left in this solution twenty-four hours, when the liquid is turned off, but can be used again on another batch of olives, and need not be thrown away. The oftener you draw off and renew the water the quicker you cure your olives. You keep drawing it off from the olives and adding fresh water from time to time until the water becomes clear. When the water becomes clear, which will take about four to six days, is the right time to put in the brine. I had a great deal of trouble as to the required strength of the brine. I found that when the brine is made too strong it causes the olives to shrivel, and hurts them to such an extent that they cannot be marketed; and I tried it by taking one ounce, two ounces, and so on, to the gallon of water, and I find that fourteen ounces to the gallon of water will keep the olive better than anything else. I have olives from last year that I have kept in a perfect state, and the color has not left the olive. I forgot to say one thing, that the principal trouble in curing olives has been that they take a few pounds of potash or caustic soda and simply put it in water. Never weigh or measure the ingredients. Now, you can take out of the same vat or barrel or can of potash one pound of potash or of caustic soda, and put it in the vat. The next time you come to put in another pound, and calculate on one pound to the gallon, and so on, you will make a mistake, because the potash is less or more in strength according to the time it has been exposed to the air; the second time that you put it in it will average at least two or three degrees less in strength. A hydrometer should be used always, by all means, and if you put in just eight ounces of chemically pure potash, six ounces of lime, and six quarts of water, you will find that it will register between five and five and a quarter degrees; it is very hard to make it register by weight just so much; it will not do it. After this liquid has settled you can draw it off from the top, and the top liquid will register five degrees; yet you can stir up what lies on the bottom, and even add more water, and it will register up to nine degrees; the potash settles on the bottom. There should be the greatest of care in this. There are other methods. This one was tried on the Mission olive. You can take the same ingredients, the same strength of lye, and apply it to such an olive as the Pendulina, or some of the new varieties, and it will hurt the olive to such an extent as to render it worthless. This treatment will not do for the other varieties. The Mission olive is the toughest olive I know of. I have some of the fruit now that I have been treating with water for one year, and they are still bitter. I have not put anything else in—not a drop of salt—but I have simply been changing the water all this time, and the olives are as perfect as at the time they were put in. I have a couple of bottles I want to pass around. The first is the Mission olive, grown on the foothills, which were put in the lye in October, now about three weeks. These others are a variety called Pendoulier. This olive, under the same treatment as the other, will not do. You can take and keep this one as I did in the same strength of lye, and in a week they will be so soft you will have to throw them away. It is the same with all the new varieties. You have to adopt a system of processes with each, separate from the other. In reference to the statement that the olive does not bear in Fresno: I was over to Mr. Roeding's place some time ago, and those [referring to a branch of olives] are some off his trees, and I have seen no place where those varieties did as well as they do on his place.

Mr. Sanders: I believe I have the only olive tree in Fresno County which has been bearing nine years. It is a biennial bearer, which I believe is characteristic with the Mission olive, making wood one year and bearing a crop of fruit the next year.

Mr. Kimball: There is nothing that is more palatable than olive oil. I do not mean cotton-seed oil, or peanut oil, or a mixture of the two, but I mean oil such as President Cooper and myself make and sell. I can say this: that a man almost loses his desire for meat of any kind if he will use with baked potatoes, olive oil, with a little salt. I prefer it to the best sirloin steak that was ever cut; it is not one fourth of the time that I touch the steak. And I stand here to say further that a pound of olives pickled when ripe will stand for a man to do his work with the pick and shovel better than the best pound of meat he ever ate. There is no reason why a man should not eat them, except that people don't know anything about it; they do not know any more about olive oil than the people of Fresno do about this Convention. I hope to live to see the day when olives will be as common on our tables as meat or vegetables, and I believe I will. I appeal to my friend here who has been to those countries which I have not, to say if there are the same number of people on the face of the earth enjoying a greater degree of health than those of Italy, where it is the exception rather than the rule for a workingman to eat meat more than twelve times a year. They are far healthier than we are; and when we abandon the use of so much fat meat and substitute in its place olive oil, we will find a healthier generation than we now can.

Mr. Mosher: I would like to make a statement in regard to the olive. Until about a year and a half ago I was very much troubled with dyspepsia; in fact, I had to live on the most careful diet—it was misery, you might say. I commenced to eat olives, and I will state that I am very much improved in health. I think my dyspepsia is entirely gone, and my appetite is good. I had suffered a great deal for several years, and commenced improving right away after using the olives. In regard to olive oil, I was recommended to take it, and I went to one of the first stores in San Francisco and called for Mr. Cooper's olive oil. I didn't know anything about Mr. Cooper, and they showed me Mr. Cooper's oil and said it was $1 75 a bottle, but that they had a superior oil for $1 a bottle, which, they claimed, was imported. They recommended it highly, and advised me to take that, and I foolishly took the dollar bottle. My wife took part of a glassful, as it was recommended for her, and the result was we had to call in a physician. He said he was just in time; he thought her life was in danger. She suffered greatly. It had a kind of poisonous effect, although since then she has taken Cooper's oil and it had no unpleasant effect. The so called imported oil was very disagreeable to the taste—nothing like the pure oil.

Mr. Sanders: I wish to give my testimony as to the matter of eating olive oil. I was down to brother Kimball's a few years ago and he told me that story about eating olive oil, and I got some of Cooper's oil in San Francisco. It was kind of milk-like, not so clear as the other, but we took it home and put it on baked potatoes, and, with salt, it was finer, I must say, than any good fresh butter I ever tasted. I have eaten it constantly since, and it has had just exactly the effect that brother Kimball said it would in dispelling every symptom of dyspepsia. We eat it constantly.

Mr. Lelong: There has not been, as we know, any imported oil so far, brought here that is as clean as ours. We have no diseases of the olive in California, while in Italy and in France they have to crush their olives because they are full of worms, vermin. From that they make the oil that we get here, and that is the reason that it has injurious effects upon our system. In cases where there is no disease the olives are always gathered up green for pickling, but in every case the olives are crushed for oil because they are diseased and cannot be used for pickling.

Mr. Kimball: I want to add something. My Superintendent is an Italian by birth, made oil in Italy, made oil on the Quito farm, in Santa Clara County, and he says there is not one fourth, and, perhaps, in many cases not one fifth, of the olives in Italy that don't have a worm in them from a quarter to three quarters of an inch long.

Mr. Freeman: Can any one tell whether there is a possibility of getting pure olive oil in the market in this country, and as to the extent that adulteration has been carried on?

Mr. Kimball: I will answer it from the lips of Commissioner Le Duc, Commissioner of Agriculture, while at my house examining my oil and olives, having previously been to President Cooper's. He told me that, out of sixty-eight or sixty-nine samples of oil taken from as many different importers in the United States, all represented to be pure olive oil, only one sample exceeded 74 per cent of olive oil, and that sample contained about 92 per cent; the rest were from 74 per cent down to absolutely not a trace of olive oil. The experiments were made under the Analytical Chemist of the United States, at Washington, and he, of course, knew whereof he spoke.

MEMORIAL TO CONGRESS.

Mr. W. H. Aiken, for the committee appointed, presents the following memorial to Congress, which was adopted:

Memorial of the Fruit Growers' Convention of California.

To the honorable the Senate and the House of Representatives of the United States in Congress assembled:

Your memorialists, the fruit growers of the State of California, in their annual Convention assembled, at Fresno, California, this eighth day of November, 1889, most respectfully represent:

That the climate and soil of this State are adapted to the growth and preparation of fruits of good quality and in quantities sufficient, eventually, to supply the demand for such products in the United States, especially prunes, raisins, figs, olives, and olive oil.

The success of this enterprise is of the greatest importance to the State and nation.

That the spread of scale insects from foreign countries in California threatens the continued successful cultivation of fruit trees subject to their ravages. Parasites have been found in foreign countries—especially Australia—that live upon and destroy the scale.

Your memorialists, therefore, respectfully and earnestly request an appropriation that will enable the Department of Agriculture to import to this country parasites for scale insects.

PICKING, PACKING, STORING, AND MARKETING OF FRUITS.

DISCUSSION.

Mr. Cooper: This is one of the most important matters which fruit growers have to consider. I am engaged in the nut business, and found last year, in my county, a difference of 4½ cents a pound in the sale of the English walnut of the same variety and the same quality, simply for the want of a combined effort on the part of those interested as to the proper mode of disposing of this fruit. It was not the fault of the market, it was simply the want of a proper method to market, and the disposition on the part of some to take the low prices, and many of the nuts were put in competition against themselves. I would like to hear from Mr. Buck, who is manager of the California Fruit Union and knows more about this subject, probably, than any other man in the State.

Mr. Buck: As Mr. Cooper has said, I perhaps do know something about marketing the fruit we raise up north. I have had but little experience in the marketing of nuts or other products, but I verily believe that what is true of one is true of all. As President Cooper has well said, the ruinous prices that are often received are the result of one man's product selling against another's. In my judgment, the way to realize the most money from the product of a locality, is for that section, be it large or small, to have some sort of organization. It facilitates shipping, it enables the man who has but little to put that little with the product of the man that has a large quantity, and get the benefit of carload rates of freights. Now, the California Fruit Union has handled a large amount of fruit for the last four years, and the present season has about closed, if not entirely, and I believe that this season has been one of the most prosperous that we have had. Four years ago the organization was in its infancy, and we had nearly every shipper and buyer in the State to compete with and oppose. The buyer, as a rule, did not want the growers to succeed; they wanted them to be placed in that position where they were forced to take the price that the buyer might offer. But while the patrons of the California Fruit Union that continued to ship throughout the year made but little money, I think the buyers made less. And the result was, that the second year, several of the leading buyers in the State were willing and anxious to, and did work with the California Fruit Union, and have done so ever since. The California Fruit Union has not handled all of the product of deciduous fruits of this State. Had they or any other organization handled all the fruits that had been shipped to the east of the Missouri River this year, I believe that the entire net proceeds of the same would have been at least 25 per cent more than it has been; because in that case, all the markets would have been fairly supplied; and one market would not have been glutted while another was left bare. Of course there are large markets in the East where fruit always brings a price either high or low, with any average supply, but that is not true in many smaller places; these are easily overstocked. The demand for California fresh fruits in the East has certainly increased very largely; the amount that can be disposed of at the present time is very largely in excess of what could have been disposed of a few years ago. In fact it has become almost a necessity; and the product of California the fruit stands are obliged to buy, whether they want it or not. They take a little California fruit and mix with baskets of domestic fruit, and put on top to sell their fruit. I do not mean by that that the shippers do that, but I mean that the fruit stands do in making up their baskets for retail. This year the grape shipments have been very profitable as a rule, and a cause of it has been that the product of California has shipped well this year; has had good keeping qualities, and has gone there to sell against a very light and a very poor domestic grape crop, which was not the case a year ago. Then the California grapes as a rule carried badly, and they went against a fine domestic crop in the East. I do not wish to be understood as saying that the shipping of deciduous fruits to the East is not a risky business. You are liable to meet contingencies which no man can foresee, circumstances which your fruit will not stand up under, such as hot sultry weather after striking the Missouri River, and from there to the point of marketing. All of those things no man can foresee, and are causes oftentimes of serious loss to a shipper; but as an offset to that, there are certainly many times in which the shipper receives a generous price for his fruit. There is much to learn about the conditions of keeping the fruit. One of the chief causes of serious loss is the shipping of imperfect fruit; peaches with split pits, pears or other fruit with worms in them; and here I will say that peaches are not exempt from worms either. There were a great many worms in the peaches shipped this last season; the later peaches were more free from them. This section has never shipped green fruit very largely to the East, for some reason; either that there is not the fruit, or from the fact that some shipments that have gone from here have not been very profitable. In going around through the section here I see that you have a large number of pear trees, and I do not know why your pears should not ship well from here. I think they have not been shipped, though, to any extent.

Mr. Sanders: Are late pears profitably shipped East—Easter Beurie or Winter Nelis?

Mr. Buck: Yes, sir; they are, if they are free from worms; if you can ship a pear that will be a winter pear when it gets there, it is certainly profitable, and it will bring a high price. One trouble with pears that are shipped from here for winter pears is, there are too many worms shipped with them, and they have got to be repacked, and there is so much shrinkage that it is sometimes not profitable; by worms I mean the codlin moth.

SUN-DRYING FRUITS.

Essay by C. G. Calkins, Tulare.

The following plan was devised wholly by me nearly two years since, but so far as I am informed has never been used by any one else.

Although patentable, I have never sought or intended to secure patents, and now for the first time have undertaken to bring it to the notice of intelligent fruit growers:

PLAN, ETC.

A case of suitable size, say eight to ten feet long, six feet wide, covered with glass, mounted on two wheels, or by some pivotal arrangement, so it can be turned to the sun at all times, and also tilted to receive the sun's rays at the proper angle. The details can be contrived by any mechanic or practical fruit drier.

In view of what Ericsson, Professor Morse, and others have demonstrated, and by practical tests of the thermometer, of the *great increase* of heat gained by receiving the sun's rays in inclosed spaces, through glass, can any philosophic and practical mind doubt for a moment the expediency and economy of a plan essentially such as this?

All the reasons for desiring to dry fruits in brief time, in less space, in a cleanly mode, saving them from contact with damp and chill, thus preventing discoloration and other injury, will be present in all intelligent minds turned to the subject.

Will not some one or more, by experiment, test this method?

As one detail, I would propose that trays be entered at the floor of the case from each side, removable at will, their outer ends forming a complete closure of that part of the case. A funnel for ventilation should rise from the higher end, as high as convenient.

COÖPERATION OF FRUIT GROWERS.

Essay by B. N. Rowley, San Francisco.

History furnishes us with abundant proofs that all great results have been accomplished through organized efforts systematically managed. As individuals we can accomplish but little, comparatively speaking, but as members of a properly organized body all obstacles, however great, may be overcome and much valuable work accomplished. No other industry stands so much in need of organized coöperation as fruit growing, particularly in California. We need more local horticultural societies; each and every fruit district should have and maintain one. We have at present quite a number of well regulated societies from which a vast amount of good has resulted, but we need more, and they should be better attended and more liberally supported.

We should go still further, and perfect local district associations in each fruit section or district for the purpose of devising ways and means for the more successful handling and marketing of the district fruit crop. To be sure, we have several local shipping associations of considerable prominence, and two combinations or organizations engaged in shipping fresh fruits to the East. All of these are doing splendid work in their way, but individually and collectively they fail in the most important part, that of

net profits to growers. This failure is not so much the result of the methods employed as it is a lack of proper organization. Each association or organization at present is working on an independent basis, and petty jealousies and grievances are allowed to influence their actions and interfere with their workings, to the detriment of all parties concerned.

Is it not possible to organize one grand association of California fruit growers, to be composed of district associations? Let us give this matter a little further thought. First, let the State Board of Horticulture, or, if you please, this Convention, appoint a Committee on Organization. This committee will district the State, and designate by name or number each district, and appoint a district deputy organizer for each district, whose duty it will be to take up the work of organization, make a personal canvass, and call a public meeting of the growers in his district for the purpose of further perfecting the district association. Rules and by-laws to govern the same should be uniform throughout the State, and furnished by the Committee on Organization, subject to the necessary alterations and changes in general convention later on. As soon as the district deputies report the formation of district associations, and the State has been thoroughly organized, the committee will call a State Convention, to be composed of delegates from all district associations, selected by the members at a regular meeting and instructed as to the wishes and requirements of their district. The delegates thus selected will assemble in convention and formulate plans to govern the district associations, and for the proper, successful conduct of the fruit business of the State for the coming year. Each district association should be required to keep one or more competent men in the field from the commencement of each fruit season for the purpose of gathering information and statistics regarding the coming crop. This information, as collected, should be forwarded to his association, the manager to forward the same to the office of the State association, there to be compiled and furnished collectively to each district association for the use and benefit of its members.

Fruit growing for profit in California is a business, and those engaged in it should be business men. As such, being producers and manufacturers, they should seek to keep themselves well informed as to the quantity and condition of crops, market prices, transactions, freight rates, and all matters pertaining to or connected with the business of fruit growing. The importance of the information that could thus be gathered and distributed cannot well be overestimated. By the aid of such an organization, the question of marketing either fresh or dried fruits would, we think, become comparatively easy and profitable. The question of overstocking any particular market at any particular time could be successfully guarded against. The quantity of dried fruit that could be profitably marketed in any one year could, without great difficulty, be arrived at.

The matter of reliable statistics regarding the fruit business is of vital importance to all fruit growers. With an organization known as the "Fruit Growers' Association of California," properly organized and in working order, a wonderful reform could be wrought from the present crude methods of marketing both our green and dried fruits. At present our fruits are competing against themselves in nearly every market in the land. Without proper organization and coöperation on the part of California growers, it will be next to impossible to bring about a desirable state of affairs among fruit growers. Our system of distribution is faulty, charges in many transactions are excessive, and consumers are called upon to pay fancy and even extravagant prices in order to make the business profitable as conducted at present.

Coöperative drying could be successfully conducted through the district association under the organization above outlined. This system of producing dried fruits would have the effect of making uniform grades and concentrating supplies, and what is most important of all, the conducting of the business of fruit drying at a much less cost than it is done at present. Sales of round lots of dried fruit of uniform grades at a given point under one management would certainly prove much more profitable to the producer and buyer than under the present methods of traveling the length and breadth of the State, picking up small, odd lots here and there, and concentrating them at some given point for the purpose of making a merchantable grade. Buyers pay but little attention to small lots of ungraded fruit, but seek to save time and money in purchasing straight carload lots at shipping points. An eastern house, sending a buyer to California, must necessarily add the expense of that buyer to the purchase price of the fruit, which, coupled with the high freight rates, necessarily makes the laid-down cost in the eastern market excessive, and the consumer is compelled to pay almost prohibitory prices in order to indulge in the luxury of eating California dried fruit. All this should be changed. If the entire product of a district could be handled under one management, the matter of quantity and quality and the expense of ascertaining such facts on the part of buyers would certainly be placed at the minimum. Time and money would be saved and general satisfaction given, which is not the case with the present methods of handling our dried fruit products.

Our present methods are certainly a great improvement over the old cumbersome style of doing business, but there still remains a vast field for improvement. A State fruit growers association, properly organized and put in operation, would certainly bring about a new order of things in California. All the difficulties which now present themselves can be overcome, and then, like all other well regulated branches of trade, fruit growing and drying in California would become one grand success. With the proper system and methods of distribution and reasonable freight charges for reaching the various markets of the country, the question of over-production will become a thing of the past. The matter of a State fruit growers' association in California is one, we think, that ought to be considered by this Convention at this time, and we respectfully submit the matter for your kind consideration.

DISCUSSION.

Mr. Buck: Mr. Rowley is a gentleman I know very well, but I don't think he ever raised much fruit, or shipped much fruit; and I don't think he ever went into the country and attempted to organize the fruit growers of the locality and get them all together. I think it would bother him to go to the people who get their mail at any one Post Office in the State of California, to control the fruit of that one locality, to say nothing about the State. Now, the organizations that are in the field at the present time, are the California Fruit Union, which has been in existence and operation for four years, and the Earl Fruit Company, which has been nearly as long, and beyond that quite a number of individual shippers. The average fruit grower, whether he ships his fruit green or dried, will, as a rule, sell at any reasonable price that he can get, and to any man who will buy at that price. There are a few in the State whose products are large, and who have shipped every year, and will ship regularly a portion of their crop; but there are only a few in the State of the very large growers that are willing to hazard their entire crop by shipping it East. Now, if what Mr. Rowley suggests should be accomplished, it would be a great, grand thing; and the man who could do it would be worthy a great deal of credit; and the proceeds that would emanate from such an organization would be grand. But I believe that I have had about as much experience as anybody in trying to get fruit growers to organize and stay together, and I tell you that it cannot be done. And I don't believe that there is any organization that can spring out of the ruins of those that we have now that will be any stronger, or as strong. If the fruit growers would join one or the other of the organizations that we have now, we could get better results than attempting to organize a new one. The organization of anything of that kind costs considerable money to start with, and it meets a good deal of opposition to start with—much more than would come from the growers as against the organizations already in the field. If the unions that are in the field could, as I said before, concentrate, it would result in a great deal of good, both in effect and in the influence they would have upon the railroad companies for reduced rates, and for concentration of products, and in the distribution of the products in the East. I would not envy Mr. Rowley the work of organizing the fruit growers of this State into one grand body for the pooling of their whole crop, and I do not believe that they will ever succeed in it.

Mr. Rice: I believe that to the State Board of Horticulture is due the organization of your fruit union four years ago at Los Angeles. The promoters of the scheme tried to take in the rest of the State, and I remember very well what a wonderful hot time the people from the north had down there in trying to persuade the southern part of the State to join this union. They organized a union of their own at Los Angeles that lived just one year. I was Secretary of it, and I wish to give a few figures as well as I can remember them, of the effect of the coöperation of that one year. The freight on oranges per carload, I think, allowed us to ship three hundred boxes to Missouri River points for $300. After the people of this union that were down there had stirred the people up in Southern California, the very best and most influential men, those who had the largest orchards, agreed to form a union of orange growers and ship their oranges as one association. They secured pledges of orange crops that aggregated twelve hundred carloads to go through the union, out of about two thousand two hundred carloads that were grown in Southern California—a little over half of the orange crop. They sent their President with a resolution to see a railroad company, we have two—the Southern Pacific and the Santa Fe, which had then just got ready for business. We wanted a lower rate of freight to start with; this was demanded from both companies, and both companies immediately came down $50, $250 a carload. Mr. Rose, who was the President, was authorized to make any other deal that he could privately, with either road. He said to the Santa Fe Railroad and the Southern Pacific: "We will ship our twelve hundred carloads over one route; what will you do for us?" The Santa Fe road said: "We will do what anybody else is doing." The Southern Pacific said: "If that is the system of business, we will give your combination $25 for every car you ship over the road." That was a reduction of $75 a carload for oranges to start with, which left a handsome profit for Southern California orange growers; if they only got the bare actual cost for their oranges, that alone would have paid them. So much for coöperation. The union had a system, I presume, something similar to the one that Mr. Buck presides over, in having telegraphed from the different markets of the East the condition of the market and the supply. At Kansas City, to illustrate, we did not consign a single carload during the season, for the reason that when a trainload of our oranges would reach that point, our agent was there and said that Kansas City was already overstocked, and every man that shipped to that one market, and several others, lost money. One fruit grower withdrew from the union and shipped through a large house that was in existence in San Francisco at that time, and absolutely came out in debt at the end of the year, with a very large stock of oranges. But the final result of the combination was, that before the season was over there was so much jealousy between the different shippers and growers, because one man would occasionally get a little larger price than another, that the whole thing went to pieces. The trouble is, the farmers and fruit growers are not ready to organize under Mr. Rowley's or anybody else's plan, and I think that if this fruit union that is in existence now can keep its head above the water a few years longer, it may rally around it a very large support. It is true that almost every class of people on the face of the earth can unite in some coöperative scheme except farmers. Even the school children of Portland, I believe it was, a few days ago went on a strike, and brought the teachers and the Board of Education to terms, and they don't switch in that school any longer. The bootblacks, even, have formed an organization. The newsboys in St. Louis a few years ago made a strike on the "Evening Post," and would have compelled that establishment to close up its doors if it had not conceded to their demands. If the people of Fresno don't organize a raisin growers' exchange, and handle their own raisins, and I am not sure but pack them, too, it will not be very long until middlemen, or a combination of them will have you under their heels. They will count up the exact price for which it is possible for you to sell, the same as some railroads have been accused of doing in exacting freights.

Mr. Hickmot: I agree with Mr. Buck in one thing, that is, if we have different associations, that we can get more knowledge and a better chance of finding out what the markets are than we can as individuals, and if we have an association we can get the advantage of carload rates, if we choose to ship through them according to the judgment of the Board of Directors. If each district in this State would form a district association, and then work through some central head to market the product of their sections, they will do it much more intelligently than they can as individuals. They will get the knowledge; they will get experienced packers to handle the fruit, and that is one of the chief things we want. A great many of the fruit growers of this State have lost money shipping East, from the fact that the fruit was not packed properly; and, also, from being ignorant as to the proper point to send fruit that *is* packed properly. If we could form an association where the fruit growers of a district could meet together and discuss the matter they would know how strong they are, and they would find out about their neighbors' crops and how much had been offered; they could be in communication with the Secretary or Treasurer of some other district association, and thus every fruit grower of the State would know about how much the crop of the State would be. Then, if he has any knowledge of what the markets demand, he would know about how much he ought to get for his fruit. I have been a fruit buyer in this State for ten years and have purchased from one to two thousand tons a year, and I know that it is owing to the ignorance of the grower himself that the buyer has got in and made his money. If you go into a district where they are organized you have got to pay the market price for that fruit; if you do not, you pit one grower against the other, and play upon his feelings until you get him where you want him; that is the way it is done as a matter of business, but if you could form district associations that would be avoided. And as to drying of fruit. We have formed an association at Haywards; we cannot say that we have met with great success so far; we were ignorant of how to do this thing, but it is only through practical experience that we learn to do anything. We could not get anything for our cherries down here this year. I bought cherries for a cent and a quarter a pound. This was for want of organization. We did ship some cherries East, and we did very well. We lost some, but it was owing to the weather and inexperience as to the proper way of packing. Then I called a meeting of the growers. Some of us had apricots that were not fit for market, and we wanted to dry them. I have no facilities for drying my apricots. We formed an association and we dried them. I had the pleasure of entertaining a very large buyer of California fruit from Philadelphia, and I called his attention to the fact that we were going to unite and dry our product as a whole. He said, "Mr. Hickmot, that is just the thing you ought to do; the great fault with your dried product here is that we cannot send a man on the road without half a ton of samples; but if you could get a regular product, a carload all alike, I would like very much to buy it." When the time came I was informed by a letter that a gentleman from Philadelphia desired to see me. I went over, and said he, "You have got some dried fruit." I said, "Yes, there is some over there on the ground," and he went over there and saw it. We did not have to hunt a market for ourselves; we brought them to us, and, therefore, we had the advantage. He asked the price of the product; we put a price on it and he took it, and we are well satisfied with that return. We did not have to go all over San Francisco hunting a buyer. It was the same with our prunes. I marketed the last lot of prunes the other day at very good prices, which the individual grower could not get in San Francisco. I sold at better prices than I could get individually. This will show the necessity or the advantage of coöperation in each district. As Mr. Buck says, the organization as outlined by Mr. Rowley is very large, but I frankly believe that the day will come when we will see the necessity of doing it. The growers of California are shipping fruit into the San Francisco market. I know of an instance where a grower received a letter from Sacramento saying that the market for peaches in Sacramento was 5 cents better than in San Francisco. He sent a lot to Sacramento and got 10 cents less than he would have got in San Francisco; so with all our markets; if we had an organization we could distribute our products to a much better advantage than we are doing now.

Mr. Buck: A few more words in reference to organization. The thing of all others that would result with the most advantage is local organization, which should connect itself with some general organization, or work as a local organization independently, still to their advantage. Now, the section of the State that has probably made the most money out of eastern shipping is around Vacaville, and it is better organized than any other one in the State. There are several other places that are fairly well organized, and they have done well; for instance, Florin, Sacramento County. Their shipments are almost exclusively grapes. Heretofore they have sold—one man a little and another man a little, and the result was that the grower had but little margin. This year they have loaded and shipped about forty carloads through the union, and they have got good prices. Of course, I don't think that this is all the result of their shipping through the union; this was a decided advantage. Now, as Mr. Hickmot has well said, the proper direction to start, and the proper place for this organization, is not at the head first, but with primary organization in the neighborhood in which fruit is raised, whether it is two men or twenty men. It is a very easy matter for a few men to load a car, but it is not a very easy matter for one man, unless he has a very large crop, to load a car in a day.

Mr. Hickmot: I have a ranch in Sacramento County, as well as one in Alameda, and a year ago I could not give my grapes away. The Florin district I am well acquainted with. I have been dealing with the growers there for a good many years. A year ago I could not give my grapes away in Sacramento County. We sold them to the winery at $7 a ton. This year we were paid $35 a ton right at the vineyard for our grapes, and no questions asked at all, and the baskets and boxes furnished there—simply from the organization at Florin. The growers tell me themselves that they have sold their grapes to the organization this year as high as $130 per ton net to them—am I right or wrong?

Mr. Buck: There have been individual cars even higher than that, and I think that the net of the forty cars of that neighborhood that were shipped from Florin to the Fruit Growers' Association would be somewhere from $75 to $100 a ton, and that included two or three cars that were delayed by the burning of the snowsheds up in the mountains three or four days. They were three or four days overtime, so that they arrived in a bad condition, and didn't sell well. There is another thing that might be said, and I am very glad Mr. Hickmot is here, because he can substantiate what I may say: The buyers for the canneries of the State of California are generally pretty smart men, and they take in the situation before they talk to you, and make you a price; and in very many cases the first sales are not very high ones, and I believe that the organization that has been working at Vacaville and Winters has done more to hold the prices of apricots than any one thing in the State of California. I would like to ask Mr. Hickmot if he does not agree with that statement?

Mr. Hickmot: Yes, that is a fact; a fruit buyer don't go to Vacaville very much, if he can get what he wants away from there. They are all posted, and know what to ask.

Mr. Buck: When he does get there, he has to pay a drying price, if he don't in other localities.

PRUNING.

DISCUSSION.

Mr. McLaughlin: In our county (Fresno) most everybody has an idea about vine pruning. We find that all climates and all soils do not require the same kind of pruning. I will state the mode of pruning we follow in our climate, from an experience of seven years. First, we shovel out around the vine pretty well down, clean out all the rubbish, get below the suckers that have been allowed to grow. We trim them off very snug, close in as we possibly can without breaking the bark, and then we select the healthiest spurs, those that will divide, to balance the stump, and especially those on top that will protect the stump from the sun. We govern ourselves altogether by the size of the stump of the vine; in many cases with vines that are planted at the same time, one limb has a much thicker growth than another, without any apparent cause; we know the small one will not require the number of spurs that a large one does. In a vineyard of six years of age, on a good healthy vine we leave from eight to ten spurs, each containing two eyes, usually cutting about one inch outside of the outer eye that we leave. A square cut is the best. We cut the others as close to the head as we possibly can, knock off the rough bark, and pass on. Under that kind of pruning we have obtained the best results. As I said before, we do not want to overgrow small vines with rubbish; it is not rubbish we are after, we are after grapes; and by being careful, we usually attain the best results from that kind of pruning. I am speaking now of the majority of the pruning in the Washington Colony. In some instances, I have known men to leave six or eight spurs, with four or five eyes on each spur. That kind of pruning is very fast going out of practice; in fact, it raises a vine so high from the ground that the wood of the vine, when it is grown, breaks down and leaves the head shooting up through the brush; the sun has full power upon it, and before the grapes are ripe they are sun-burned. Therefore, with the Muscat grape, keep the heads well down, and prune short. We have had better success with that pruning than any other we have practiced in our neighborhood, where we are largely engaged in grape culture.

Mr. Sanders: I saw some very excellent pruning being done on my way here this morning; I came up twenty-five miles right through the fruit regions, and that pruning was being done by a band of sheep. I believe that whatever treatment you bestow upon your vines there is nothing that will take the place of putting in a band of sheep and cleaning everything out in the fall. In Spain the vineyardists say, "Where the sheep's foot touches it turns the earth to gold." I believe we will in time learn that same lesson here, that we have to have some means, and the sheep afford the best means, of cleaning out everything on the foliage, of treading down and paving and packing the surface, and so preparing it for the perfect healthy growth of the vine, and the more perfect imprisoning of insect pests. I don't do much pruning about my place; you can tell that by the size of the fruit. I have not touched the pruning knife to some of my trees for five years. I am in the business of raising fruit, and if I prune too closely the trees oversap, as my good, old English father used to express it; that is, there is an excess of sap, and they will drop their fruit. They will make a great growth of wood and foliage that we wish to avoid, and on the rich land where I live we produce thousands of tons of weeds per acre, speaking after the manner of men, the more including the less. You must not overprune your fruit. The prune trees that I went to gather some prunes off this morning, the trees that bore the ripe prunes have not had a knife touched to them for lo! these many years, I cannot tell how many, and they are full of prunes to the present time; some of the prunes are here in the back end of the room.

Mr. Johnson: I want to say to this Convention that I have tried the sheep, and as long as I am in the vineyard business I will never allow sheep in my orchard if I can help it. Last fall the sheep men came around and paid 25 cents an acre to pasture there. They brought three thousand head over to our place and pastured over the vineyard three times to get the green wood and leaves, and everything else, and then the rain came, and I got them to take the sheep away. About ten acres had no sheep on it, and this part sprang up with alfilerilla, which we plowed under and enriched the ground, and had no more trouble with the weeds. The part that the sheep had passed over was very cloddy when plowed. We plowed, harrowed, and did everything we could, and it is cloddy yet. It is three times as hard to work as where they had no sheep. Some of my neighbors said the sheep would eat up the leaf hopper, but the leaf hopper is there. I don't want our friends to go away with the impression that it is a good thing to have sheep over the vineyard; I am very much opposed to it, and our neighbors have agreed not to repeat the experiment. Our ground is not absolutely dry, it is sub-irrigated wonderfully; in some places you can strike water at three feet and other places at six feet, except now, when the water is out of the ditch. The ground is moist half an inch from the surface, and they packed it terribly.

Mr. McLaughlin: I quite agree with the gentleman who made the statement about the ground being packed on top. In our vicinity we tried the sheep for a number of years, and our experience is the same; but the greatest damage that the vines receive is from the sap being up at the time, and the moment the foliage is removed by an unnatural cause, a pressure is formed to force the sap in, and it has got to find an outlet somewhere, and it goes into the body of the vine. This swells the bud so that, in many instances, it is rendered unfit to go another year on account of the sheep taking the foliage on the vine. I have seen a vineyard that the sheep were on which the following year did not raise half a crop.

Mr. Kells: I will ask if the sheep were put on for the purpose of pruning the vines or for some other purpose?

Mr. McLaughlin: They were put on to get rid of the rubbish and foliage, so that it looks easier when the man goes in with the pruning shears, and some say to get rid of the vine hopper.

Mr. Sanders: In answer to Mr. Kells' question I will say that I put them into my vineyard to clear the ground out from weeds, and clear the vine; and our discussion here illustrates a characteristic of California. It is twenty-three feet to water where I live; the ground to-day can be handled like ashes; you can't pack it; and where these other gentlemen live it is very moist. I remember writing an article about fruit, and Mr. Hobart took me to task in two columns and a half of the "Rural Press," and the local papers spent about four columns in my defense. I was talking about the conditions of this locality, and Mr. Hobart about the conditions of the Ojai Valley. This is the same. It may be necessary for me to put sheep in my vineyard and not at all necessary for them.

Mr. Kells: Do you consider it right to prune before the leaves shed on the grapevine?

Mr. McLaughlin: No. We plow lots of the roots off of our vines. The first year it might possibly injure the vines; afterwards the vines wouldn't be as healthy if we allowed those surface roots on, because the bottom of the vine can only throw out so many spurs, so much root, the same as the top, and if we take away the superfluity the other roots are healthier and grow stronger and healthier and deeper down to give moisture to the vines. The rubbish we plow under, and it makes a fertilizer.

Mr. Kells: I would like to give a little of my experience in the northern part of the State. We pastured sheep in our vineyard. We knew that while they were feeding off the leaves, and so forth, they were taking the fertilizers off the ground, but we thought they were cleaning out the hoppers to a great extent. Our soil is composed of black loam, about twelve feet to water, and we never yet found any difficulty in cultivating our ground the following spring after pasturing the ground with sheep; our only object is to get rid of the hoppers. Our method of pruning is something similar to that which the gentleman has referred to. We prune according to the age and the size of the vine, and what we think it can support; and we aim to do our suckering in the spring, as the suckers start out, perhaps making two suckerings of them.

A Delegate: I would like to ask in regard to the pruning of the French prune trees. It has been recommended in this country that after the second or third year they do not require pruning. I have a few trees on which I tried to follow that style. They grew so large and so high that I now top them off a little every year. I think if I did not, they would reach so high that it would be very hard to pick the fruit. I have read that in the northern part of the State they summer prune in order to prevent trees from bearing too heavy, and in other places they do not summer prune. I have read that by summer pruning we could produce larger crops on the apricot trees. We started a few years ago, in the locality where I live, to summer prune our apricots, and the most of us for the last year or two have abandoned it; and I have come to the conclusion that in this climate and soil the apricot tree would do better by not being summer pruned. I think it depends on the kind of soil. I notice that those which were not summer pruned have borne better crops than those that were. I have a few peaches also. I think that is a tree that will stand a good deal of pruning in this soil and climate to keep it from making too much wood and bearing too heavy crops. The peach tree will set in this country full of fruit. In our locality we have to go to a good deal of pains to keep them from bearing too much. Another point: When I prune a peach tree in the winter time, a man who is conversant with fruit and trees can tell by its appearace how much fruit that tree is going to bear next season. The buds are all set during the pruning time. I believe it is a great benefit to a peach tree in this country to be pruned heavily. Later in the season, after all the pruning with the knife we think it will stand, we thin the fruit out afterwards; some do it with poles and some with pitchforks, but my trees have all been done by hand. The consequence is, that the fruit I have had to put on the market will always take the highest price. Now, in regard to pruning, there are so many different trees and so many different methods. One tree grows up straight—the Hungarian prune, for instance. A man that is growing that kind of trees, if he takes pains and prunes, can spread the tops of the trees by cutting the branches off where you cut and leave the outside bud to grow. The peach tree wants to be cut just the reverse. That is of a great deal of importance in regard to pruning different kinds and styles of trees. I do not know anything about citrus trees, but I believe the generality of trees need some kind of pruning. If any tree does not, it is the French prune.

Mr. Sanders: I would like to ask if peach trees ever require thinning after you prune them. Do you prune them so close that they require no thinning of the fruit?

A Delegate: It has invariably been the case with me that after pruning as much as I dared, I had to thin out the peaches by hand. I believe that the peach crop is the one that pays the best in this locality. I generally begin pruning in January. I think you should begin earlier, immediately after spraying; I spray every year with the solution of sulphur, salt, and lime.

Mr. Gladden, of Healdsburg: I have been cultivating the French prune for fifteen years, and we have now in my locality some pretty large orchards, from five and six acres to thirty and forty. It has got to be the leading interest in that locality of the Russian River Valley. When we first began to raise prunes we knew nothing about pruning, and we did very much with them as we did with other trees, and the result of our first pruning of prune trees was that they were some four or five years old before we had any fruit. We invariably thinned them out to the proper number of main branches and cut off the top—cut them back three or four buds near the top—and where they were cut off, they put out strong canes, strong shoots, and grew up and made a very thick top; straight, nice switches, I would call them. They remained thus until another year, and were thinned out some and topped again, and the people kept on that way. I believe I was the first one in the neighborhood to advocate the idea of not topping every year, but thin out; have the proper number of main branches and leave the switches the full length. Some of my neighbors said: "If you do that they will grow out of your reach entirely." The result was that they did not grow out of my reach; they made a very small growth at the ends, but they put out a number of lateral shoots all the way up that branch, and filled with fruit buds, and bore fruit in another year. I have certainly discovered that I am raising more fruit on trees four or five years old than I did by cutting the tops back, for in that way we raised wood instead of fruit. I have prunes which have not been topped back the last three years. I don't want too much bearing wood, I want it thoroughly thinned out, and I don't cut off the tops more than about once in four or five years, and then I try to do it judiciously. The first trees I ever planted have never been trimmed at all, having been planted sixteen years ago this winter. They are healthy, and bore about five hundred pounds to the tree last season on gravelly soil. But I would say that I think I shall cut the tops back a little this winter. I am like the gentleman across the room, I am entirely opposed to cutting a prune tree like a peach tree; if you do that you will have but little fruit. We don't think we have a very good crop of prunes unless we have on trees six to eight years old, three to four hundred pounds of prunes, if not five hundred. I had trees eight years old this season that produced five hundred pounds per tree. They have not been topped back for three years, but have been thinned a little.

A Delegate: That would be about one hundred and thirty pounds of dried fruit?

Mr. Gladden: Yes, sir. I will say I could not give any regular rule, owing to the difference in climate, soil, and so forth; in the Russian River Valley, where my orchard is, I have raised fifty to seventy-five bushels of corn per acre, without irrigation, the corn having no rain after it was planted. It was matured and gathered without rain. I have three acres now in prunes that one year yielded one hundred and two bushels of corn per acre without irrigation. We do not keep cutting our prune trees back all the time. If we do, the result is that just where we cut off the shoots, they will throw out new branches and run up beyond it to be cut off another year. I think, when trees are two years old, and have five or six nice branches which are to form the tree, they extend these switches, as I call them, three or four more limbs, and the next year, if you cut them off a little higher, and another year the same thing again, there are your new buds on these switches. But if you leave them they throw out these lateral branches, and perhaps they will not be the additional length of that pencil to the top of these switches. You may leave them for years and they may bend with the load of fruit, but if you keep cutting them back they will not bend much with the fruit. We prune our prune trees less than any other trees. I don't know anything about Damson plum trees, I don't grow them; but I have Yellow Eggs, Coe's Golden Drop, Silver prunes, and a few other kinds. All those I prune pretty much as I do these prune trees, perhaps cut a little more.

Mr. Sanders: What stock are your prunes on?

Mr. Gladden: Peach, mostly; I have some Myrobolan and a few almond, but I prefer the peach for my soil better than any other stock. Mine is a deep, porous, sandy loam, well underdrained, on which the peach root does well. The trees have a rapid growth, and I have seen shoots in one season fourteen feet long.

A Delegate: Do you cut those off at all?

Mr. Gladden: Yes; I shall cut a little this winter, but be very careful about it. All of those bent over a good deal, and I will cut them back some.

Mr. Mosher: When all of those two-year olds bear full of fruit, don't they bend clear over on to the ground?

Mr. Gladden: They did this year, for the first time being troublesome; the trees are twenty feet apart; and, therefore, I say that I shall cut them back some. I think it will add a little to the size of the prune, and, as I said before, I think it is best every three or four years, not every year, to cut them back. My prunes this year were smaller than they were last. Last year they averaged fifty-eight to the pound without grading; this year it was seventy-six without grading. In regard to peaches, we had almost a failure last year. My cash receipts for peaches last year were about one fifth of what they were the year before at the same price; they were well pruned a year ago and made an excellent growth. I never saw better in my life, and they bid fair to be a good crop. We cut the peach tree back every year. We can't cut enough, however; the fruit must also be thinned, and the best way to do this is by hand; it cannot be well done with a pole; there will be bunches, and bunches of peaches can't make good peaches. I want peaches about six inches apart; that is as close as I want them together, and it is very hard to get inexperienced persons to thin enough. I thinned an orchard of Orange and Lemon Clings, and one of my neighbors came to see how I thinned them. Said I, "What do you think of it?" "Well," said he, "as you have asked me, I will be honest and tell you that I think you have ruined your crop; look on the ground." I said, "Never mind the ground, look on the tree. I will have to go over them again and certainly take off nearly half of what you see there." He was very much astonished, but I did go over it again.

Mr. J. A. Gordon, of Saratoga: It is well known that prunes are sold at graded prices, commencing at 4 to 4½ cents for small prunes and raising as high as 9 to 10 for large sizes. During this season I purchased the crops of a great many orchards in our vicinity, Saratoga and Los Gatos, where my orchard is located, and I found that the prunes grown in our vicinity where we pruned back heavily ranged about 75 per cent of medium to large size, while the prunes that I bought from other sections of the county and adjoining counties, where they did not prune the way we do, ranged about 75 per cent of very small to medium ones. The result was that on the prunes that I bought outside of our own district I lost money, while on those that I bought in my own district where the trees had been heavily pruned, I made a handsome profit.

A Delegate: How far do you cut back?

Mr. Gordon: We generally cut back about one half of each year's growth; we cut back every year not quite so much as we do the peach, but very nearly.

A Delegate, from Fresno: I would like to know how to increase the apricot crop by pruning. I have a very fine looking orchard, and only a portion of it bears fruit to any extent. I have given it all the care and attention that I could; I have summer pruned, winter pruned, and I have let it run. A portion of the orchard on sandy land has never failed in three years to produce a crop, and those which are situated on white ash land are much the larger, healthier looking trees, and were six years old last spring, and I will venture to say that I have not in three years got a box of fruit to the tree.

Mr. Mosher: I will offer the suggestion that the gentleman send some of the earth to the State University and have it analyzed. There may be some ingredient that is lacking in the soil that could be added, and put the orchard in bearing.

A DELEGATE: There may be an idea that the varieties are different, but Mr. Thomas, of Visalia, furnished the trees, and they appear to be the same, so far as I can tell. I am somewhat timid, after our experience, about sending soil to the University or anywhere else. We sent some hardpan and alkali soil to the State University in order to have it analyzed, to know whether there was any remedy for this affection of our vines, and the answer came back that "there is no alkali, perhaps, in all the San Joaquin Valley, that is any particular detriment to the growth of trees or vines." We know better.

MR. SANDERS: I believe this complaint about the non-bearing of apricot trees is general throughout our valley. I know seven different orchards in our vicinity, and in the seven orchards I know of only one tree that has produced regular, heavy annual crops, and that is a Hemskirk tree standing right near my barn; while twenty-two trees standing a little further up the road have failed year after year; and I believe it is a matter of a general failure in our valley of the apricot.

MR. MASLIN: I have no opinion to offer, but I will give a few facts from my observation. There are three counties in this State that surpass all others in the raising of apricots. One, Solano County, in the Vaca Valley. The apricot does not fail there; every kind of apricot grows there. In the Santa Clara Valley the apricot crop is very abundant, and all kinds of apricots grow. In the Santa Clara Valley, in Ventura County, are found the largest and finest apricots grown in the State of California, and in neither county is there a complaint of the barrenness of the tree or the quality of the fruit. I only state that as a fact, and my opinion formed from those facts is that the apricot will only grow to perfection where it has the influence of the sea breeze.

MR. SANDERS: I believe that is correct. I will state that of the non-bearing trees in my orchard a certain number are Moorparks, a certain other number Royal, seven Jackson seedlings; and I have one that bears heavily of the Hemskirk, and that is right near the barn where the rains run from the barn cleanings, and that may be the reason of that bearing. The others that do not have that advantage don't bear.

MR. BUCK: I want to correct an error. Mr. Maslin said that all varieties bore well in Solano County. That is not correct; the Moorpark, of which there are almost none, are very shy bearers. Indeed, I don't suppose there are five hundred trees in the county, and they bear very seldom. It is not a prolific bearer, but I have seen it bear heavily; the Royal is our best.

MR. COATES, of Napa: I agree with the gentleman that there is a great difference in the varieties, and also with Mr. Buck's remarks as to there being a great difference in the variety in different localities. The Moorpark is a heavy bearer in the Santa Clara Valley generally; I think it is the principal crop there and also in Alameda County. In Napa and in Solano it is a very shy bearer indeed, and there the Royal is the main variety, with the Blenheim as a very good second.

MR. MCLAUGHLIN: We know very little of what kind of trees we have, unless we get experts to examine them. Some years ago I bought five hundred apricots, and I will guarantee I have got seven different kinds of apricots, including a very few Moorpark.

MR. COATES: It is sometimes found necessary to induce bearing by checking the wood growth, and that checking of the wood growth is the reason why summer pruning is sometimes recommended. I think the gentleman on the other side of the hall mentioned summer pruning a few minutes ago, but he followed it with a system of irrigation and flooding; of course, that counteracted the very object he intended to attain by his pinching or summer pruning, for at the same time that he summer pruned and checked the wood growth, he should have turned off the water, and probably the results would have been different.

MR. MOSHER: I would like to ask the gentleman if the foliage on his trees that don't bear comes out at the same time that it does on other trees; if the tree blossoms, or if it has any matured fruit.

A DELEGATE: I will answer the question very briefly. The growth of the foliage, fruit buds, bloom, and all come at the same time, look to all appearances the same, and are all healthy. I don't think I have an unhealthy tree in the orchard of nine acres, and no disposition towards disease of any kind; but as soon as the fruit buds on the trees on the white ash land swell, and have opened, all you have to do is to shake the tree a little and they are all on the ground in half a minute. They generally commence about the twentieth of February to the first of March blooming—the Moorpark and the Royal are about the same—but during the month of March, when they are in full bloom, the bloom may be shaken off the tree with a very small effort. I have never noticed any difference in the appearance of the blossom. The only root pruning I ever attempt to do is to plow and take off all the surface roots I can. I have often thought it would be beneficial to do what we call circular root pruning—dig a circle around each tree. I have plowed as deep as I can plow, and turned the surface roots up to see if that would benefit them any, and the trees have then made a fine growth of wood, and seemed to throw out a good quantity of nice fruit buds until about blooming time, when they fall off.

MR. THOMAS, of Visalia: I want to ask if any one has produced a regular crop of apricots throughout this valley.

MR. SANDERS: On sandy land good apricots have been produced in this county; quite a number of trees have borne well, but no large orchards that I know of are on sandy land, so that I would not dare to include sandy land.

PROTECTION OF FORESTS.

MR. MASLIN: The whole State of California is interested in the protection of the forests of the Sierra Nevada. The citizen himself will not take the pains to protect the forests. This year, in July, I had occasion to cross Lake Bigler, and stopped at the hotel. As we crossed the lake I saw a little cloud rising in the heavens. I asked what that was, and a man on the steamer said it was a fire, probably left by a sheepherder. After a little I saw another little cloud, and asked Mr. Dudley about it, and he said it was probably another sheepherder's camp. Three or four times I asked the people about the hotel why they did not go up there and put the fire out. Nobody seemed to care for it; the land belonged to the Government, and what was everybody's business was nobody's business. In a few weeks a forest ten miles long and over a mile wide was burnt, never to be reclaimed within our time. The whole length of the Sierra Nevada in summer is trodden down by the sheepherders' trails, and it will not be long before the great waters upon which we depend for the future will be surely lessened from want of nourishment and the preservation of the snow. I should have prepared a resolution, but I have been so interested in the discussions of this Convention that I have not done so. It seems to me proper that this Convention should request the State Board of Horticulture—having more time—to prepare a proper memorial to Congress, asking Congress to withdraw these lands from settlers, and to prevent the use of them by nomadic sheepherders. I would therefore move that the State Board of Horticulture be requested to prepare such a memorial to Congress as would command respect.

A DELEGATE: I think others destroy timber as well as the sheepherders. In the Santa Cruz Mountains some of the finest bodies of redwood timber in the world have been recklessly destroyed by millmen taking all the young timber simply to get out a few logs. They cut down two or three logs and set fire and burn all the brush and rubbish around the hills. It seems to me they should be required to remove their wood without destroying the young timber, if it is possible to do so.

MR. MASLIN: The statement of the gentleman is no doubt correct that the lumbermen do any amount of damage, but the trouble is this, that the title has passed from the Government of the United States to the citizens, and it is not possible for the Government to tell the lumberman how he shall use his lumber; nor can the citizens of California say how a man who owns a section of land should use it. The Government, however, can withdraw from sale these other areas to which it has still the title, and reserve it for a grand park for us and our posterity. I think the people of California should arouse themselves to a proper consideration of the importance of this subject. The watersheds must be protected in the Sierras, especially against coming down on the irrigated portion of the State; otherwise, when the first warm weather of the summer comes, the snows will melt all at once, and the water will sweep down in a perfect cataclasm on the plain, and be exhausted when we want it for irrigation. It does not concern us so much for the next few years as it does those who come afterwards. It is a very important matter that we should reserve these lands and the watersheds. We are willing and desire that all the State should be interested, and if we do not do this the land will be taken up by speculators, and the first thing we know the forests will be devastated, and we will be subject to floods; and all of the great San Joaquin Valley and the irrigated portions of the Sacramento, and portions of the southern part of the State, will be relegated back to the condition of the desert.

The motion is carried.

MEMORIAL OF THE FRUIT GROWERS OF CALIFORNIA.

To the honorable the Senate and the House of Representatives of the United States, in Congress assembled:

Your memorialists, the fruit growers of California, in Convention assembled, this eighth day of November, 1889, most respectfully represent:

That the importance of preserving the forests of the Sierras and other mountains within and bordering on this State has become apparent to all the people of the State, and more especially to the farmer, agriculturist, horticulturist, and viticulturist.

That vast areas in this State have and many thousands of acres more will be transformed from the desert to beautiful homes and fruitful orchards, thereby adding millions of dollars to our wealth.

That experience and common sense teach us that it is incumbent upon the National Government to preserve for us and for future generations the waters of these mountains, to the end that our agricultural and horticultural interests may be best conserved, and that the marvelous resources and the splendid possibilities of this State may be most successfully developed.

That irrigation is recognized as the absolute necessity for the present and continued prosperity of this State, and that irrigation can only be continued by the perservation of the mountain forests, a fact too well known to require mention. Therefore, be it

Resolved, That we, the fruit growers of this State, in Convention assembled, most heartily and earnestly petition the Congress of the United States to speedily enact a law providing amply for the preservation of said watersheds, and for excluding from entry such portions as may be necessary, and properly policing the territory embraced in said watersheds.

RESOLUTIONS.

MR. RICE offered the following resolution:

WHEREAS, Mr. Hughes, the father of Fresno, in the kindness of his heart, has made a reduction in the regular rates to guests stopping at his house, that he be tendered a vote of thanks, not only for the reduction, but for the magnificent table he has spread, and the accommodations to members since they have been here, and for numerous other courtesies extended.

Carried.

On motion of MR. PECK, it is ordered that a vote of thanks be tendered to the people of Fresno.

On motion of MR. LELONG, a vote of thanks was tendered to Mr. S. H. Coles of Fresno, for his attendance and efforts to make this session of the Convention pleasant.

On motion of MR. MOSHER, a vote of thanks was tendered to Professor Sanders for his attendance at the Convention.

On motion of MR. LELONG, a vote of thanks was tendered the Board of Trade of Fresno, and the Convention adjourned sine die.

XXXIII.

EXTRACTS FROM MEETINGS OF THE BOARD.

San Francisco, Cal., November 21, 1888.

The meeting was called to order by President Cooper. The following Commissioners were present: President Cooper, Vice-President Peck, Commissioners Block, Dr. E. Kimball, F. A. Kimball, Runyon, and Vallejo. Absent: Commissioners West and Boggs.

The minutes of meeting of July 2, 1888, were read and duly approved.

Adjourned to meet November twenty-second, at one o'clock P. M.

November 22, 1888.

The meeting was called to order by President Cooper. The following Commissioners were present: President Cooper, Vice-President Peck, Commissioners Block, Dr. E. Kimball, F. A. Kimball, Runyon, and Vallejo. Absent: Commissioners West and Boggs.

The report of the Secretary was read and placed on file.

Commissioner Block moved that all bills for office furniture be paid. Carried.

The report of the Treasurer was then read and placed on file.

A letter was read from W. M. Boggs, announcing his withdrawal from the Board. On motion, the Secretary was instructed to acknowledge its receipt.

(Vice-President Peck in the chair.)

Commissioner Block moved that the Chair appoint a committee of three to report as to the wants of the Board, and changes deemed necessary in the laws governing the Board.

Carried.

Chairman Peck appointed Commissioners F. A. Kimball, Ellwood Cooper, and Dr. E. Kimball.

The Board then adjourned to meet at the call of the President.

November 23, 1888.

The meeting was called to order by President Cooper.

The following Commissioners were present, viz.: President Cooper, Vice-President Peck, Commissioners Dr. E. Kimball, F. A. Kimball, Runyon, and Vallejo. Absent: Commissioners West, Boggs, and Block.

The minutes of November 22, 1888, were read and duly approved.

(Vice-President Peck in the chair.)

Commissioner Cooper requested the Secretary to withdraw during the executive session.

The Secretary withdrew.

Commissioner F. A. Kimball, Chairman of the committee on the revision of the present laws governing the Board, and changes deemed necessary, presented the report of the committee, as follows:

To the President of the State Board of Horticulture, and members thereof:

Your committee appointed to make a report on the increase of appropriation necessary for the use of the Board, as also changes deemed necessary to be made in the horticultural law, submit the following:

First—That the appropriation be increased to $20,000 per year, $5,000 to be paid to the Treasurer quarterly, in advance.

Second—That the horticultural year commence April 1, 1889.

Third—That the office or position of Inspector of Fruit Pests be abolished.

Fourth—That the sum of $400 per month be allowed for competent office service.

Fifth—That a sum not exceeding $1,000 be allowed for traveling expenses.

Sixth—That the expenditures necessary to be made in experiments in the different districts to be determined by the Board, on application of one or more of the fruit growers in such districts; the Board to select such person or persons to make such experiments, and pay the expenses thereof.

Seventh—That all County Horticultural Boards be required by law to report quarterly to the State Board, in writing, of the condition of the fruit interests in their several districts; what is being done to eradicate insect pests; also, as to disinfecting, as to quarantine against new insects, and as to carrying out of all laws relative to the greatest good of the fruit interests.

FRANK A. KIMBALL,
EDWIN KIMBALL,
ELLWOOD COOPER,
Committee

The report was unanimously adopted, on motion of Commissioner Runyon.

The Board then adjourned to meet at the call of the President.

November 24, 1888.

The meeting was called to order by President Cooper. There were present: Commissioners F. A. Kimball, Dr. E. Kimball, Runyon, Peck, and President Cooper. Absent, Commissioners Block, Boggs, and West.

Commissioner F. A. Kimball moved that the Eleventh State Fruit Growers' Convention be held under the auspices of the Board at National City, the date therefor to be fixed by the President.

Carried.

Commissioner Peck moved that the Secretary be allowed all hotel, and other traveling expenses during the session of the Legislature, and while he may have to be at Sacramento.

Carried.

Adjourned to meet at the call of the President.

April 15, 1889.

Pursuant to call issued by President Cooper, the members assembled at ten o'clock A. M. There were present: President Cooper, Commissioners Buck, Kimball, Motheral, Mosher, Runyon, Peck, and White. Absent: Commissioner Block.

The minutes of the previous meeting were read and duly approved.

The Secretary read his annual report, and on motion of Commissioner White, it was accepted and placed on file. (See report on page 14.)

The appointments of Quarantine Guardians made by the President in the absence of a quarantine officer, were confirmed on motion of Commissioner White.

The recommendation in the report of the Secretary for the appointment of a committee to draft a suitable set of resolutions, to be properly engrossed and transmitted to the Senators and Assemblymen, who aided in the passage of the horticultural bills, was referred to the Convention then in session.

The report of the Treasurer was then read and ordered placed on file, on motion of Commissioner White. (See report on page 9.)

On motion, the Board then took a recess until 1:30 o'clock P. M., and it was ordered that said meeting be held in executive session, for the purpose of electing officers.

AFTERNOON SESSION.

The Board met in the afternoon at 1:30 o'clock, pursuant to adjournment. President Cooper in the chair.

The roll was called, and the following Commissioners answered to their names: Commissioners Buck, Kimball, Mosher, Motheral, Runyon, Peck, White, and President Cooper. Absent, Commissioner Block.

(Vice-President Peck in the chair.)

The Chairman announced nominations for the position of President in order.

Commissioner Runyon nominated Commissioner Cooper for the office of President. Commissioner Buck seconded the nomination, and moved that nominations be now closed.

Motion carried.

Commissioner Buck moved that the Secretary be and is hereby instructed to cast the vote of the Commissioners present for Ellwood Cooper for the the position of President of the Board.

Motion carried.

The Secretary cast the vote of the Commissioners present for Ellwood Cooper for the position of President.

The Chairman (Mr. Peck) announced the unanimous reëlection of Commissioner Cooper as President of the Board.

President Cooper, in taking his seat as President, thanked the Commissioners for the honor they had bestowed upon him.

Nominations for the position of Vice-President were then declared in order.

Commissioner Kimball placed Commissioner Peck in nomination for the position of Vice-President.

Commissioner Buck moved that nominations be now closed and that the Secretary be directed to cast the vote of the Commissioners present for Commissioner N. R. Peck for the office of Vice-President.

Motion carried.

The Secretary cast the vote of the Commissioners present for N. R. Peck for the position of Vice-President.

The President declared Commissioner Peck duly reëlected.

Nominations for the position of Secretary were then declared in order.

Commissioner White nominated B. M. Lelong for the position of Secretary.

Commissioner Buck moved that nominations for Secretary be closed.

Motion carried.

President Cooper appointed Commissioners Motheral and Mosher tellers. Total number of votes cast, eight. B. M. Lelong received eight votes.

The President announced that B. M. Lelong, having received the unanimous vote of the Commissioners present, declared him reëlected Secretary.

Commissioner Peck moved that the Secretary be and is hereby tendered a vote of thanks as the sentiment of the Board for the services performed by that officer during the past two years. Complimentary remarks were made by the Commissioners present.

Motion carried.

Nominations for Chairman of the Finance Committee (Auditor) were then declared in order.

Commissioner Mosher was nominated, and declared elected unanimously.

Nominations for the position of Treasurer were then declared in order.

Commissioner Sol. Runyon was nominated, and declared elected unanimously.

Commissioner White moved that the election of Clerk of the Publishing and Quarantine Bureau, and that of Special Agent, be deferred until some future meeting.

Carried.

The Secretary announced the appointment of Miss Ella Hallahan as his Clerk, and asked that the appointment be confirmed.

On motion, the appointment of Miss Ella Hallahan as Clerk was confirmed.

On motion, the Board then adjourned, to meet at the call of the President.

APRIL 19, 1889.

The Board met in pursuance to adjournment, President Cooper in the chair.

The following Commissioners answered to their names, viz.: Commissioners Buck, Kimball, Mosher, Runyon, Motheral, Peck, White, and President Cooper. Absent: Commissioner Block.

A communication was read from W. G. Klee, wherein he claimed a salary warrant for the month of January, 1889.

On motion, said subject-matter was laid on the table.

On motion, the election of a Clerk of the Publishing and Quarantine Bureau, and that of Special Agent, was deferred until a special meeting of said Board to be held on June 29, 1889, at 1:30 o'clock P. M.

On motion, the arrangements for the next Convention were deferred until some future meeting.

The Board then adjourned to meet in San Francisco on June 29, 1889.

SPECIAL MEETING.

JUNE 29, 1889.

The Board met pursuant to a call issued by Hon. Ellwood Cooper, President of the Board, for the following purposes, in pursuance to a resolution adopted at the meeting of the Board, April 19, 1889:

First—To appoint a Clerk of the Publishing and Quarantine Bureau.

Second—To consider the advisability of appointing a Special Agent for field work.

Third—To consider the advisability of sending an expert to Australia and New Zealand, to collect and import into this State parasites destructive to scale and other injurious insect pests.

Fourth—To formulate quarantine regulations in conformity with the law.

The following Commissioners answered to their names: President Cooper, Vice-President Peck, Commissioners Buck, Kimball, White, Motheral, and Mosher. Absent: Commissioners Runyon and Block.

The President announced that nominations for the position of Clerk of the Publishing and Quarantine Bureau were in order. Commissioner Mosher nominated George Rice. Commissioner Kimball seconded the nomination. Commissioner Motheral nominated Charles B. Turrell. Nominations were, on motion, closed.

The President appointed Commissioners Mosher and Motheral tellers. Total number of votes cast, seven. George Rice received seven votes.

George Rice was declared duly elected.

Commissioner Buck nominated N. W. Motheral for the position of Special Agent. President Cooper nominated D. W. Coquillett. Nominations were declared closed. Commissioners Buck and Mosher were appointed tellers. Number of votes cast, eight. N. W. Motheral received seven votes. D. W. Coquillett received one vote.

N. W. Motheral was declared duly elected.

The following quarantine regulations were unanimously adopted:

REGULATIONS TO PREVENT THE SPREAD OF CONTAGIOUS DISEASES AMONG FRUIT AND FRUIT TREES; AND FOR THE PREVENTION, TREATMENT, CURE, AND EXTIRPATION OF FRUIT PESTS, AND OF DISEASES OF FRUIT AND FRUIT TREES; AND FOR THE DISINFECTION OF GRAFTS, SCIONS, ORCHARD DEBRIS, EMPTY FRUIT BOXES, ETC.

All purchasers who shall receive fruit in any box, sack, or other package of any description, shall immediately upon receiving the same disinfect each box, sack, or other package, by subjecting it to boiling water or steam under pressure for a sufficient length of time to destroy all insects or germs attached to or contained in such box, sack, or other package; and all such boxes, sacks, and other packages shall be kept secure from infection so long as they remain in the place where disinfected.

Disinfection of Fruit Trees, Scions, Etc.

For the purpose of disinfecting fruit trees, scions, cuttings, grafts, etc., the following is recommended:

Whale-oil soap (80 per cent strength)	5 pounds.
Water	4 gallons.

Directions.—Dissolve thoroughly soap in water, and immerse the tree, scion, cutting, or plant for at least two minutes, while the solution is still hot, or for such length of time as will destroy all insects or germs.

Pernicious (Aspidiotus Perniciosus) Scale.

Summer Remedy for Peaches.

Potash	14 pounds.
Caustic soda (98 per cent)	8 pounds.
Lime unslacked	5 pounds.
Fish oil, polar or seal	10 gallons.

Directions.—First—Dissolve the soda and potash by placing them together in about ten or twelve gallons of water.

Second—Slack the lime in a barrel in two gallons of water: then add the fish oil to the lime and stir well until the lime and the oil have turned to a thick batter; then add the soda and potash, water, boiling hot, and stir well with a dasher for five minutes or more. Leave standing for about four or six hours; fill up with cold water; do not pour in all the water at once, but about two buckets at a time. Stir well as the first two buckets of water go in to prevent lumps. Use the following day. Apply cold, one pound to the gallon of water. In dissolving it do not boil, but weigh the amount to be used, place in a barrel, and on top of it pour hot water, about one bucket to every hundred pounds of material. After pouring in the hot water, stir lively with a dasher until it is entirely dissolved, then reduce with cold water until sufficiently thin to pass through the strainer; then place in the tank and fill up with water; stir well and it is ready for use; apply cold.

Summer Remedy for Pears and Apples.

Caustic soda (98 per cent)	10 pounds.
Potash	10 pounds.
Tallow	40 pounds.
Resin	40 pounds.

Directions.—First—Dissolve the potash and soda in ten gallons of water. When dissolved, place the whole amount in a barrel (fifty-gallon measure).

Second—Dissolve the tallow and resin together. When dissolved, add the same to the potash and soda in the barrel, and stir well for five minutes or so. Leave standing for about two hours, then fill up with water, stirring well as every bucket of water goes in. Use the following day, one pound to the gallon of water; apply warm.

Winter Remedy.

Lime	25 pound
Sulphur	20 pounds.
Salt	15 pounds.

Directions.—Take ten pounds of lime, twenty pounds of sulphur, and twenty gallons of water; boil until the sulphur is thoroughly dissolved. Take the remaining fifteen pounds of lime and fifteen pounds of salt, and when thoroughly slacked, mix together and add enough water to make in all sixty gallons of solution; strain and spray warm.

Brown Apricot Scale.

Summer Remedy.

Caustic soda (98 per cent)	1 pound.
Resin	5 pounds.
Water	40 gallons.

Directions.—Boil caustic soda in one and one half gallons of water. When dissolved, take out and lay aside one half of the solution; then add resin to the remainder in the kettle. After resin is dissolved, add slowly balance of soda solution. When thoroughly cooked, add water to make in all forty gallons of solution; apply warm.

Winter Remedy.

Sulphur	20 pounds.
Lime	25 pounds.
Salt	15 pounds.

Directions.—Take ten pounds of the lime, twenty pounds of the sulphur, and twenty gallons of water. Boil until the sulphur is thoroughly dissolved. Take the remainder—fifteen pounds of lime and fifteen pounds of salt—slack, and add water to make the whole mixture sixty gallons. Mix the whole together, strain, and spray on the trees milk warm or warmer. This can only be applied when the foliage is off the tree, and has in this condition no injurious effect on the fruit buds or tree whatever.

For Cottony Cushion (Icerya Purchasi) Scale.

Caustic soda (98 per cent)	2 pounds.
Resin	10 pounds.

Directions.—Boil caustic soda in one and one half gallons of water. When dissolved, take out and lay aside one half of the solution; then add resin to the remainder in the kettle. After resin is dissolved, add slowly balance of soda solution. When thoroughly cooked, add water enough to make in all forty gallons of solution; apply warm.

For Black Scale (Lecanium Olea) on Olive Trees

Five gallons best kerosene oil, 150 degrees test; one and one fourth pounds good common soap, or one bar and a half of soap usually sold as pound packages; two and a half gallons of water. This makes the emulsion. When using, dilute six and one half gallons of water for each gallon of oil, and to this mixture add two and a half pounds of good home-made soap dissolved in boiling water. All this mixing should be done with hot water, and applied at a temperature of 140 degrees Fahrenheit.

Red Scale (Aspidiotus Aurantii) on Citrus Trees.

Caustic soda (98 per cent)	8 pounds.
Resin	15 pounds.
Whale oil or fish oil	2 quarts.

Directions.—Boil oil, resin, and caustic soda together in about ten gallons of water for about three or four hours; then add water enough to make in all one hundred gallons of solution. Apply warm. Must be cooked well as per directions, to secure best results.

For Codlin (Carpocapsa Pomonella) Moth.

For Early Ripening Apples and Pears.

Spray once with one pound of Paris green to one hundred and eighty gallons of water, when just out of bloom.

For Fall and Winter Apples and Pears.

Spray twice. First application as above; second application with one pound of Paris green to two hundred gallons of water. Use the Paris green without any additions, simply stirring the liquid continually and straining it before using.

For Woolly (Schizoneura Lanigera) Aphis.

Root Form.—Dress liberally with ashes, especially in moist localities, or use gas lime, about one and one half shovelfuls around each tree in such a manner that it will not come in direct contact with the bark of the tree.

Branch Form.—Brush with kerosene emulsion, or resin solution, or spray.

For Flowering Shrubs or Garden Plants.

Sulphur	1 pound.
Lime	1 pound.
Water	2 gallons.

Directions.—Boil the ingredients together one hour. Dilute one gallon of the mixture with three gallons of water; use more or less water according to the strength of the plant.

BORERS.

Guard trees from infection by placing a shake or board on the south and west sides of the tree, which protects it from sunburn; or give a coating of whitewash, containing some soap and sulphur. In removing a borer, smear the wound over with grafting wax.

PEACH ROOT (SANNANIA PACIFICA) BORER.

Remove the earth at the base of the tree and wrap up the trunk with stout paraffine paper, and pile up against the paper air-slacked lime or ashes.

NOTE.—Wherever beneficial insects or parasites are decreasing the spread of injurious insect pests, no spray or wash should be used, and the parasites should be colonized and taken care of.

The following resolution was adopted on motion of Commissioner White:

Resolved, That a special agent be sent to Australia and New Zealand, to there collect such parasites that prey upon all scale and other insects injurious to fruit and fruit trees; *provided*, that said agent shall not import into this State any such parasites that are injurious to fruit, fruit trees, or vegetation, but that only prey upon any such scale or other insects.

On motion, the naming of said agent was referred to the Executive Committee, that they refer the subject-matter to the Attorney-General, as to the power of the Board.

Commissioner Kimball moved that the date for the holding of the next State Fruit Growers' Convention be referred to the President, with full power to act, and that said Convention be held at Fresno, in November next.

The Board then adjourned to meet in November next, at Fresno, at the call of the President.

NOVEMBER 4, 1889.

The Board met in pursuance to call issued by the President of the Board, at 2:30 P. M.

The meeting was called to order by President Cooper, and the following Commissioners answered to their names: Commissioners Buck, Kimball, Mosher, Thomas, Runyon, Vice-President Peck, and President Cooper.

The minutes of April fifteenth and nineteenth, and the special meeting of June 29, 1889, were read and duly approved.

The report of the Secretary was read, and, on motion, was accepted and ordered placed on file. (See report on page 18.)

The report of the Treasurer was read and ordered filed. (See report on page 12.)

The resignation of N. W. Motheral as Special Agent was read, and accepted on motion of Commissioner Kimball.

Commissioner Kimball offered the following resolution:

Resolved, That in accepting the resignation of N. W. Motheral as Entomologist of the Board, we, the State Board of Horticulture, tender Mr. Motheral a vote of thanks as our appreciation of the valuable services rendered the State during his official connection with the Board as its Entomologist, *particularly* in his successful efforts in bringing the fruit growers of the different sections together for discussion and the dissemination of knowledge so essential to successful fruit growing.

Adopted.

On motion, the Board adjourned to meet at the call of the President.

NOVEMBER 8, 1889.

The Board met in pursuance to adjournment.

The meeting was called to order by President Cooper.

There were present: Commissioners Block, Buck, Kimball, Mosher, Peck, Thomas, Runyon, and President Cooper. Absent: Commissioner White.

On motion of Commissioner Block, twenty thousand Bulletins No. 53 were ordered printed.

Commissioner Block moved that the next State Fruit Growers' Convention be held at Los Angeles, in March next, the date thereof to be fixed by the Executive Committee.

Motion carried.

Commissioner Block moved that when the Board does adjourn, it do so to meet in Los Angeles on March 10, 1889, at one o'clock P. M.

Motion carried.

On motion, the memorial to Congress on forestry was referred to the President with full power to act.

The Board then adjourned.

XXXIV.

SYNOPSIS OF THE REPORTS OF N. W. MOTHERAL,* SPECIAL AGENT.

SAN MATEO COUNTY.

The Australian beetle had been colonized at San Mateo and was doing well, and promised to rid this section of the cottony cushion scale. Black scale was found here, and indications of a parasite, which I did not find. Lace-wing flies were found, but they were not sufficiently active or numerous to accomplish much good.

At Menlo Park the red scale, the black, and the cottony cushion scale were found. At this place they seemed to be keeping all the scales in check by a wash of whale-oil soap and tobacco. The party who prepared it gave me the following as the proportions: Whale-oil soap, four pounds; tobacco, two pounds; and twenty gallons of water. The soap is dissolved, and the decoction of tobacco is then added, and sprayed warm.

In accordance with instructions, I proceeded to Los Angeles, where I arrived July eighteenth, and went at once to Alhambra. Near this place, at San Gabriel, the Australian ladybug had been colonized in an orange grove, the property of Mr. J. R. Dobbins. His orchard, at one time, he considered almost destroyed by the cottony cushion scale. The *Vedalia cardinalis* had, at the time of my visit, cleaned up his whole orchard until it was difficult to find a living scale, and the larvæ of the Vedalia were crawling over the ground under the trees by the million.

I was shown in a greenhouse in Los Angeles three new scales lately introduced upon plants from Japan and Australia. I do not think any of these scales are likely to prove troublesome, but we are all the time liable to get injurious insects in this way.

(Report July 24, 1889.)

CURCULIO.

In Instructions No. 2, I was directed to go to Sacramento and investigate the rumor that the curculio had appeared there. I examined all the fruit stands in the city handling plums; interviewed all the growers, dealers, and shippers I could find in the city, and went to the only orchard where I thought likely to find anything of this character, and failed in finding anything to substantiate the statement that curculio was in Sacramento or the surrounding country. There was no proper foundation for the report.

(Report August 8, 1889.)

NEVADA COUNTY.

The leading industry of this county is mining, and until recently but little attention has been given to fruit. The western part of the county is less than one thousand feet above the sea level, while the eastern part rises

to an altitude of eight thousand feet. The annual rainfall is about fifty inches. The land, though broken, is moderately fertile. From these facts it may be seen that the fruit industry of the county may in future assume an importance it does not now possess. All the deciduous fruits do well, and are valuable because they ripen later than in the counties at a lower sea level. This is especially true with the Bartlett pear.

The insects injurious to fruit and fruit trees found here are codlin moth and San José scale. Three fourths of the apples and pears of the county were lost this year from the codlin moth. The trees in the lower lands, where the supply of water is unlimited, have suffered greatly from scale.

There has been but little done to kill the codlin moth, except to bandage the trees with burlap and destroy the larvæ. A few parties used Paris green to a very limited extent, with no appreciable results.

SUTTER COUNTY.

This county, until recently, has been wholly engaged in agriculture. The land is level and very fertile, and yielded such bountiful harvests of grain that the inducement to raise fruit for profit was small. Deciduous fruits have been planted upon a large scale in the last few years, and the experiment has been very successful in every line of fruit planted.

The red orange scale is found on orange trees, and also the San José scale in several deciduous orchards; and the plum trees at several points in the county are infested with yellow mites.

YUBA COUNTY.

The southern and western parts of this county are comparatively level and the eastern is broken. Deciduous and citrus fruits are successfully grown in both sections of the county. There is a thermal belt along the foothills that grows fruit of every kind. Some of the finest oranges are grown here, though not on a large scale, although the largest orange grove in this part of the State was planted here last June. The orange and the olive are both being planted extensively in the western part of the county.

Trees examined in the town of Marysville were badly infested with red orange scale, and San José scale was also found in several orchards of deciduous fruits. Neither of these scales are found elsewhere in the county. The codlin moth is also found in almost every apple orchard.

[Since this report was made, a County Board of Horticultural Commissioners has been appointed, and they caused all infested trees to be most thoroughly sprayed and cleaned.]

BUTTE COUNTY.

This is a mining, lumbering, and agricultural county. That part of the county lying east of Oroville is mountainous. The miners who first settled this part of the county planted a few trees around their houses at that time, chiefly for ornament. There are a few points in the thermal belt where orange trees have been recently planted.

At Forbestown there are a few apple and peach trees, but no orchards of any commercial importance. A few persons at Wyandotte have utilized

---

* Resigned November 4, 1889.

the water of a small mining ditch and have planted oranges, olives, and almonds. These orchards look well, but have not come into bearing yet. It is evident that citrus fruits will do well, as there is in Oroville a plantain (a species of tender banana) in full bearing in the open air and unprotected. There is also plenty of water for irrigation in the rivers, of which but little has been utilized. The country around Chico has been planted to deciduous fruits extensively; also, the olive and orange are grown.

The citrus trees of this county are free from insect pests. At one or two places the soft orange scale was found, but not numerous. The San José scale is found at Oroville, but nowhere east of that point. Many of the orchards around Chico are badly infested with this scale. The codlin moth and the woolly aphis are also found well distributed over the county. The yellow mite is destructive to the foliage of the prune orchards.

The twice-stabbed ladybug was numerous in many of the orchards around Chico, and in some places evidently reduced the number of the San José scales, almost cleaning some trees entirely. The cast-off skins of the larvæ can be seen at this time clinging to the trees. At several places the codlin moth has disappeared without any known cause. I think it possible that there is a parasite at work here in early spring which cannot be found later in the season. Close observation in the spring would be rewarded with a discovery of this parasite. The larva of the lace-wing fly was found feeding upon the woolly aphis.

Sutter and Yuba Counties have a joint Horticultural Society, and it was my privilege to meet with them on the eighteenth. I saw here more interest and enthusiasm than I have seen elsewhere upon the subject of horticulture in California. At Chico there is a similar society, which had a meeting on the twenty-fifth, called by the citizens and members of the society. This was well attended, and unusual interest was manifested.

SACRAMENTO COUNTY.

At Sacramento City the Australian ladybug has spread over the city and is doing good work. Investigation in Placer County led to the discovery of the fact that peaches and plums were both injured this year by a worm. The people of Placer County say that it is only troublesome when the spring rains continue late. This can be accounted for by supposing that the moth has a parasite which is destroyed by the late rains. The salt, sulphur, and lime wash was used, producing good results and invigorating the trees. On the peach the difference before and after treating was very marked. The orange trees were clean and looked thrifty. Neither the red nor cottony cushion scale has appeared in this county.

The orchards around Sacramento are troubled with codlin moth and San José scale. But little is being done to check the codlin moth, and all the late apples are given up to them. The fruit growers are washing their trees with summer washes to kill the San José scale, and are succeeding in a measure.

Almost every fruit grower has a different remedy, but caustic soda, whale oil, and sulphur are used in almost all of them, the main difference being the proportions and manner of preparing. One thing I noticed, that where the trees were clean and vigorous the summer washes did not hurt the foliage, but where the scales had in a measure destroyed the vitality of the tree the leaves were scorched.

From Sacramento City down the river is one of the finest fruit belts in the State. Cheap freights and fertile land have stimulated the industry of fruit growing, until it has assumed immense proportions. Trees grow rapidly, and come into bearing soon. The San José scale has given the most trouble. The people spray spring, summer, and winter, and by dint of hard, persistent work keep this scale in check.

The pear slug and pear-leaf caterpillar come in each year for a share of the fruit grower's attention. The remedies used to destroy both of the insects are Paris green or London purple, one pound to two hundred gallons of water, sprayed on when the worms first hatch. A minute chalcid fly, a parasite of this caterpillar, is here found in great numbers—some four or five in each cocoon. This caterpillar has done considerable damage to the pear orchards this season in this section, but I think this chalcid fly will keep them in check in the future. This caterpillar lays its eggs the last of March, and the egg hatches in ten days; the caterpillar attains its growth in twenty days, then descends to the earth and spins a paper-like cocoon and hibernates until next spring. The caterpillar strips the pear tree of its leaves.

(Report August 25, 1889.)

EL DORADO COUNTY.

This is one of the oldest fruit-growing counties in the State, yet the business has never been extensive. Gold was first discovered here, and mining has absorbed everything else. All the deciduous fruits grow well here, and the trees bear to a great age. Both apple and peach trees may be seen at several places in the county, from thirty to thirty-five years old, still vigorous and bearing well. In sheltered places oranges grow well. The fruits ripen later in the valleys, and stand transportation better. Bartlett pears ripen the last of September and the first of October.

The injurious insects found in this county are San José scale, codlin moth, and woolly aphis. But little has been done to exterminate these pests. A few parties have sprayed with the sulphur and lime preparation recommended by the Board, and succeeded in killing the San José scale, where a shower of rain did not follow immediately after the work was done. The Paris green remedy has been used very successfully against the codlin moth.

At Placerville a public meeting was held, and a number of the prominent fruit growers of the county were present. There was considerable enthusiasm in the meeting, and by a unanimous vote preliminary steps were taken to have a County Board of Horticultural Commissioners appointed.

YOLO COUNTY.

All the deciduous fruits are grown in this county. Almonds and English walnuts are also extensively grown.

At Winters a public meeting was held, which was well attended by the fruit growers of the neighborhood, and I gave such instruction and advice as was deemed necessary to equip the fruit growers for the work of insect extermination.

At Woodland another meeting was held, and specimens of many injurious insects infesting fruits and fruit trees were obtained, and instruction given as to the most successful means used to exterminate them. This mode of procedure seemed to accomplish the design of my visit to the counties better than any other. These meetings always left the fruit growers enthusiastic, and in sympathy with the work of the Board.

For San José scale and codlin moth the remedies of the Board were recommended, and by some parties have been successfully used. For pear slug and green pear caterpillar any of the summer washes of whale-oil soap are effective, to which is added a little Paris green.

A party at Davisville (a large fruit grower) claimed to have driven off the twelve-spotted Diabrotica by the use of sulphur and Paris green. He used a bucketful of sulphur to one half pint of Paris green, and dusted this over the trees. This he did by putting the mixture in a grain sack and fastening it to a long pole, and shaking it over the trees.

COLUSA COUNTY.

At College City, Williams, and Willows there is but little fruit. At Maxwell the orchards are in good condition. At Colusa there are large orchards of deciduous fruits, and in a few places experiments are being made in the growth of the orange, which promises well. The old orchards along the river have been neglected, and as a consequence are seriously damaged by the San José scale, and the apples and pears are injured by the codlin moth; their commercial value almost destroyed. The yellow mite has been very destructive in the prune orchards this season, and in a few localities the thrips have damaged the foliage of the pear trees.

For San José scale and codlin moth, I advised the use of the remedies recommended by the Board, which have been found most successful in this part of the State, viz.: sulphur, lime, and salt for scale, and Paris green, one pound to one hundred and sixty gallons of water, for codlin moth.

I succeeded in having a public meeting at this place, and a large number of fruit growers were present. This was the most interesting meeting held during the month and the most profitable.

TEHAMA COUNTY.

At Red Bluff, or in the surrounding country, the farmers are beginning to plant deciduous fruits. All along the Sacramento River, in this county, the orange does well, and is free from insect pests. In this county I could not get a public meeting, and I found it almost impossible to get over the roads, and a few fruit growers in Red Bluff were all I could get together. Through the papers of the county I gave such instructions as I deemed necessary.

(Report October 31, 1889.)

XXXV.

COUNTY HORTICULTURAL COMMISSIONS.

REPORT OF THE ALAMEDA COUNTY BOARD.

EDEN TOWNSHIP.

The fruit interest in this township occupies a large share of the attention of the population, and from the orchards much of the wealth and prosperity has been realized.

The cherry, plum, prune, apricot, apple, and pear, currant, gooseberry, raspberry, and blackberry are at their best in this section, peaches doing better a little further south, in Washington Township. Many of the old cherry trees have succumbed to the three comparatively dry seasons, but otherwise the orchards present a healthy appearance. Paris green has been used to some extent for the checking of the codlin moth, with more or less success, corresponding to the thoroughness with which the remedy was applied. The same success may be reported in regard to the use of the remedies for the extermination of the San José scale (*Aspidiotus perniciosus*), the Greenback Company's insecticide potash being used to quite an extent for this pest.

This summer a new pest has appeared on our apricot and prune trees, in the shape of the "brown apricot scale," and is to be found in nearly every orchard. It causes the fruit to present a smutty appearance, similar to the smutty orange from scale-infested trees. For this pest we hope for a parasite, but will doubtless use some lye solution in the meantime. The growers are anxious to do all in their power to keep their properties in a healthy condition. As a whole, we think the orchards of this section will compare favorably with any in the State.

OAKLAND AND BROOKLYN TOWNSHIPS.

I have visited nearly all the orchards in my district, and devoted much time in counteracting the destructive work of injurious insects in orchards. There seems to be scarcely an apple or pear orchard free from the ravages of the codlin moth, and whenever the usual remedies have been used, satisfactory results have been obtained.

The oyster scale (*Mytilaspis pomorum*), so destructive to apple trees in this district, is decreasing, and in time may be entirely exterminated by the aid of some of the numerous parasites.

Aspidiotus perniciosus, or San José scale, is one of the most destructive of pests. Its work can be seen in the unsightly appearance of the pear and apple trees in this portion of the county. The ravages of this insect are almost unbearable, and unless proper measures are taken to keep the pest in subjection, much damage may result. It pleases me to be able to report that this injurious insect is not found in many orchards in the northern part of the county.

The woolly aphis (*Schizoneura lanigera*) is in almost every apple orchard. Concentrated lye has been the best remedy for its destruction.

Many of the orchards in the city of Alameda and Fruitvale are divided up into city lots, and very little progress can be made among so many small orchards. The hillside orchards, especially those where the trees are exposed to the winds, are nearly free from many of the scale pests.

The codlin moth, so destructive in sheltered orchards, rarely troubles the exposed fruit trees.

The nurseries of Oakland and Alameda present a healthy and clean appearance. Those who make a business of growing fruit trees and fruit appreciate the necessity of having their trees free from noxious pests, and do all in their power to have them well disinfected at all times.

Before closing this brief report, I must state that the gentlemen who are associated with me in the Board have shown a commendable willingness to coöperate with me in everything that has been necessary to free the fruit trees of the county from injurious insect pests.

WASHINGTON AND MURRAY TOWNSHIPS.

I have concluded, from the nature of the appointment and the instructions received, that the duty of the members of the County Board was to exercise a supervision of the orchards within a certain district, or within the county as far as possible, by visiting them, examining the trees, and reporting to the owners of all infected orchards their condition, and suggesting remedies for the destruction of fruit pests.

On December 30, 1886, we visited several orchards in this neighborhood, but, although we endeavored to impress their owners with the danger they courted in allowing the scale to get a foothold, and the consequences that would surely follow if not attended to by having the trees sprayed, yet I am sorry to have to state the advice has not been acted upon until within the last year, and then with not very satisfactory results.

From the last date I visited up to June, 1887, between seventy-five and one hundred orchards, large and small. I found the majority of them clean, but of those that were infested but one or two of the owners had made any effort in the matter, simply because many of them could or would not see the necessity of exertion.

In the year 1888, the San José scale made its appearance in some orchards, but not enough to create any general alarm, except with a few individuals. These parties made a determined effort this spring (1889) to destroy it, but, unfortunately, tried too many so called remedies, with the result that their efforts proved fruitless, except in one instance—a block of plum trees which were sprayed with concentrated lye.

This year (1889) the scale has appeared on all deciduous fruit trees except the Black Tartarian cherry. I find it on the peach and apricot trees, the fruit of which bears a very sorry appearance, being to a great extent covered with a black fungus or smut, rendering it almost unfit for canning or drying unless it is washed; while the leaves and limbs of the trees present an unsightly appearance by the presence of the smut.

In this locality all of the orange and olive trees are infected with the black scale. And as the orange is grown here merely for ornament, hardly any one makes an attempt to remedy the evil, or if they do, it is not done effectively, which leaves all orange and olive trees a menace which is not easy to overcome.

There is one thing certain, until a community is satisfied individually that it is a question of pocket and purse, they will not move in any matter for the public good. But the moment that they find their choice is "sink or swim," they, one and all, begin to strike for the shore.

Now, fortunately for this locality, it stands on that basis, and the outlook for the near future is very promising, that all are going to take a hand in eradicating the evil.

In conversation with Mr. H. Ellsworth, of Niles, the other day, as to what was to be done, his remark was: "If we do not get away with it, it will get away with us." Consequently I have hopes that this season will see a great change for the better, and that in my next report I will be able to state that the necessary remedies have been applied with satisfactory results.

Respectfully submitted.

A. P. CRANE,
Secretary.

SAN LORENZO, CAL., Oct. 25, 1889.

REPORT OF THE COLUSA COUNTY BOARD.

I herewith beg leave to file with your honorable Board the first report of the County Board of Horticultural Commissioners, in and for Colusa County.

Six years ago Colusa County was known only for the reputation it had justly earned for itself, as the "banner" wheat-producing county of the United States. About that time, a few energetic men, imbued with the desire for progression, planted several small orchards in the vicinity of the town of Colusa, and that it has proved a profitable investment is proven by the fact that to-day there are within the limits of the county several thousand acres of young and bearing orchards and vineyards.

A large canning and drying establishment was built during the last year, the capital stock being subscribed principally by producers, and which closed only last week. It is an assured fact, that the day is not far distant when the county will rank in the production of fruit where it always has in cereals.

Unfortunately, in the introduction of "fruit culture," as in other portions of the State, the "pests" of the horticulturist began to develop themselves rapidly, and with their extermination in view a petition was filed with the Board of Supervisors on the third day of November last, as required by the law entitled "An Act to amend an Act for the protection and promotion of horticultural interests of the State," approved March 19, 1889.

The Board thereupon appointed the following named Commissioners at large for the county: J. R. Totman, Nathan Cutler, Frank W. Willis.

Immediately on notification of appointment, the Commission met and organized, electing the following named officers: J. R. Totman, President; Frank W. Willis, Secretary; and Nathan Cutler was elected to serve for the term of one year, J. R. Totman for two years, and F. W. Willis for three years. The county was divided into districts. The following competent men were appointed as Inspectors and Quarantine Guardians: W. J. Clare, College City; Robt. Watts, Elk Creek.

The Secretary has sent out about two thousand five hundred circulars, as per inclosed, and marked No. 1, and in each was inclosed a copy of the law. The Secretary is also sending out a circular to every nurseryman in the State, as a precautionary measure against importation of diseased and infested trees into the county. See circular inclosed, and marked Circular

No. 2. The circular inclosed and marked No. 3 is explanatory in itself. We have in our orchards some of the worst enemies known to the orchardist, and with which he has to contend. We have the *Aspidiotus perniciosus* (San José scale), *Aspidiotus aurantii* (red scale), *Aspidiotus citricola* (lemon scale), *Carpocapsa pomonella* (codlin moth), *Lecanium olea* (black scale), *Anarsia lineatella* (peach moth), *Sclandria cerasi* (pear slug), *Schizoneura lanigera* (woolly aphis), *Thrips*, *Tetranychus telarius* (red spider). The cottony cushion scale (*Icerya purchasi*) has come under the writer's notice but twice, and each time on orange trees, and as soon as discovered the trees were dug up and burned. Experience in remedies for the eradication of the San José scale has led to the belief that the wash recommended and indorsed by the State Board of Horticulture, consisting of sulphur, lime, and salt, used in proportion as per Bulletin No. 53, is the most effective as well as the most inexpensive remedy tried so far. We have used alkaline washes as prescribed, but prefer the sulphur, lime, and salt, as its adhesive qualities seem to prevent the young scale from moving around after hatching, and they consequently succumb. Persistent use of this mixture will produce satisfactory results to the most skeptical.

I would like to state my experience with the *Anarsia lineatella* (peach moth). One year ago last spring I noticed a great many of the young shoots of my peach trees withering; and upon examination found that I had the peach moth to contend with. I immediately set to work destroying the larvæ as fast as they appeared, and also sprayed all the trees with Paris green, one pound to one hundred and seventy gallons of water, and I am satisfied with good results, for this year I had but very few moths. Thrips on pear trees are very troublesome to us; they work on the under side of the leaf until they absorb all the vitality, and the leaf turns black and falls off. Some experiments have been made to exterminate them, in one instance with very satisfactory results. This instance was the result of an accident, and happened thus: Last May this section of the country was a prey to a species of army worm, whose particular identity I failed at the time to discover. Its habits, to a certain extent, are similar to the army worm of the south (*Leucania imipuncta*), inasmuch as it traveled in large numbers, and its favorite food was dog fennel and the lower leaves of pear trees. To arrest the depredations of this pest I used a solution of Paris green on young trees not in bearing, one pound to one hundred and twenty gallons of water; it not only saved the trees from this worm, but prevented the appearance of thrips; while my neighbor across the road had millions of them, and they almost denuded the trees. My neighbor, E. A. Bridgeford, used whale-oil soap, but the application was made too late to judge the results. The codlin moth, so far, is confined to old orchards of a few trees, and scattered all over the county. They have enough larvæ, however, to infest the whole State.

The Horticultural Commission propose to make a rigid fight against this pest, and against these old trees, and if they deem it necessary these trees will have to be burnt up root and branch; for we surely cannot expose several thousand acres of young pear orchards, just coming into bearing, to the ravages of this most dreaded of pests. The long dry season of this valley makes it a desirable home for the red spider (*Tetranychus telarius*) and the yellow mite. Experience has taught us that a winter wash is most essential to rid the trees of these pests; one pound of whale-oil soap in two gallons of water was used when the tree was dormant with entire satisfaction. I have also used the same on almond trees, one pound of whale-oil soap, one third pound of sulphur, to two gallons of water, sprayed at about 130 degrees Fahrenheit, with very good results.

In conclusion, the County Commissioners sincerely ask the coöperation of the State Board and all county Boards, and a continuance of the courtesies already extended.

Respectfully submitted.

FRANK W. WILLIS,
Secretary.

COLUSA, December 11, 1889.

REPORT OF THE HUMBOLDT COUNTY BOARD.

We beg leave to submit this, our first report. On the tenth of July last, 1889, the Board of Supervisors of this county issued commissions to Jacob Zehndner, J. D. Barber, and A. P. Campton, as a County Board of Horticultural Commissioners, and appropriated $1,000 to be expended by the Commission for salaries and all other expenses for the first year.

On July twenty-second we met and organized, and laid plans for the work to be done in the future.

Humboldt County lies between the fortieth and forty-second parallels of latitude. The county averages about thirty-five miles in width from east to west, and the length from north to south is one hundred and eight miles. The area is three thousand five hundred and ninety square miles, larger than some of the Eastern States, and is populated with about thirty thousand inhabitants. The county possesses within her borders nearly every variety of climate common to the great State of which she forms an important part. Topographically the county may be arranged in the following subdivisions: The coast, separated from the interior by ranges averaging about ten miles in width, extending almost the entire length of the county; the "Bald Hills," the uplands of the county, principally devoted to the sheep industry; the valley lands, which range from the moist and salubrious climate of the coast to semi-tropical.

The county contains two million two hundred and ninety-seven thousand six hundred acres; which, according to the United States official estimates, may be classified as follows:

Redwood timber land	468,000
Pine, spruce, fir, and cedar	400,000
Madrona, tan-bark oak, live oak, and laurel	200,000
Adapted to agriculture	450,000
Grazing land	500,000

The remainder is at present considered of but little value, but contains much wealth of natural capability, which in all probability will be eventually developed.

Our county being so large, and the greater portion of it adapted to the growth of fruit, we have been unable to visit all the fruit-growing districts in the three months we have been acting as Commissioners. However, we have been over the greater part of the middle and western portion of the county from Mad River to Garberville, a distance north and south of about ninety-five miles by about ten miles wide. Strange to say, it would be hard to determine, at present, at what localities, from the extreme northern portion of our county to its southern extremity, a distance of one hundred and eight miles, would be the best adapted to the growth of the various vines and fruits. There is a thermal belt extending from north to south, the entire length of our county, lying just east of the redwood timber belt, and from fifteen to twenty miles from the coast, where most of the semi-tropical fruits can be grown successfully. In this belt the black walnut, English walnut, and almond bear heavy crops. The fig, nectarine, apricot, peach, prune, and grape do well, and attain a degree of perfection equal to many of the favored fruit districts of this State.

Citrus fruits are being planted with good prospects of growing them successfully. Lack of transportation facilities has alone stood in the way of the development of this section. The apple in our county attains the highest state of perfection; the greater portion of the county appears to be particularly adapted to the growth and development of that fruit. Near the coast the apple is smaller and not so richly flavored as those grown from ten to twenty-five miles back from the coast. Our apples are all free from worms. The codlin moth has not made its appearance in our county yet.

The pear does well in some localities; the Bartlett grows to an immense size, but has a tendency in most localities to ripen from the inside, and if not picked a little green will not keep well. The Winter Nelis does not do well here; it is troubled with fungus or blight, so common to it in some other localities in this State. We have found but one locality in this county where this variety matures properly without fungus or blight. We have quite a variety of other pears that do well here that we will speak of in our next report. The peach does well back from the coast, in the warmer belt, in localities where the north wind does not strike. They grow to a large size and are of excellent flavor. The principal varieties grown are Briggs' Red May, Early and Late Crawfords.

Choice apricots and nectarines can be grown over a large portion of our county.

Plums and prunes of all varieties are grown in every portion of the county. This fruit seems to take naturally to our soil and climate, and thrives exceedingly well. Perhaps there is no portion of the State where the French prune can be cultivated more successfully than in this county. The tree grows very thrifty and bears abundantly; the fruit is large and sweet, and when dried makes a first class prune. Many thousands of them are being planted every year. The Fellenberg, German, Hungarian, and Silver prunes that are grown here are of a superior quality. We know of no plum or prune but what will grow and fruit well in our county, unless it is the Washington plum, which is a shy bearer with us.

Cherries grow well all over the county, especially in Eel River Valley. The cherries grown in this section are the equal of any raised anywhere in the State, although they do not ripen here as early as they do in some sections. Grapes are not grown in large quantities, although we have plenty of territory that will produce fine grapes of excellent quality. All small fruits, such as strawberries, raspberries, currants, etc., grow and produce abundantly.

While Eel River Valley is well adapted to fruit raising, the Klamath and Trinity River sections are equally so. Along these two rivers all kinds of fruits do well, especially the grape. When this section is made more accessible it will be a great fruit-raising section, and will show results that will compare favorably with those of any other portion of the county.

All fruit grown in this county is grown without irrigation, the soil having sufficient moisture to grow the trees strong and thrifty without it.

The orchards that have been planted from twenty-five to thirty years and properly cared for, are doing well and producing large quantities of fruit, while others of that age that have not been properly cared for and not pruned and cultivated sufficiently, are looking bad and the fruit is small.

Of late years there are thousands of fruit trees being planted every season. Of the young trees that are now coming into bearing we cannot speak too highly. The trees are of strong growth, and the fruit all that can be desired. In the lower Eel River Valley, and near the coast, all fruit trees must be protected from the northwest wind by a wind break of some kind, while further up the rivers it is not necessary, owing to ranges of hills that afford shelter from the coast wind.

We have quite a variety of insect pests affecting our orchard, garden, and ornamental trees, such as the "flat headed apple tree borer," "woolly aphis," "green aphis," "red spider," "pear slug," "oyster-shell bark louse," "filbert," and "San José scale," most of which have been shipped into the county on nursery stock and fresh fruit from the infected districts of the State.

Woolly aphis has been on the apple trees in this county for many years, and many of the old trees are suffering severely from the effects of it. The remedies used have been gas lime sprinkled around the roots of the tree as far as the limbs extend, and wood ashes close around the base of the tree, and the trunk and top of the tree sprayed with "Petaluma carbolic wash." We have examined orchards where this wash has been used and find that it has done much good. Although it has not wholly destroyed the aphis it has killed the greater part of them and greatly invigorated the trees that have been sprayed with it. The oyster-shell bark louse is found on apple trees near the coast, where it appears to thrive best. In the interior it is found less frequently and does not cover the trees so completely as it does nearer the ocean, where the atmosphere is more humid. In some localities the scale appears on the fruit, causing it to be unsalable. We have not used anything successfully on it yet in this county.

Pear slug has done considerable damage this season by eating off the epidermis of the leaves of the cherry, pear, and plum. We have tried almost everything to destroy this pest. Air-slacked lime discourages it more or less, but it is not sure to kill the slug. We find that buhach powder, dusted over the trees, is sure to kill every slug that it touches, but this is expensive; we would like to find some cheaper way of destroying them.

Red spider is spreading over the fruit-growing districts of our county, and doing some damage to the apple and prune.

San José scale we found in different portions of the county, in several places doing considerable damage. We found it on apple, cherry, peach, pear, and prune trees, and in one instance on a rose bush that was close to an infected apple tree. Many of the trees infected with it were dead and others dying, while those it had attacked this season were in not so bad a state, yet they were suffering severely from the effects of it. Where we found one or two trees infected with it in an orchard, and the remainder clear, as far as we could see, we advised the owner of such trees to dig them up and burn them. Most of the fruit growers have followed our instructions, and destroyed such infected trees. Where we found an orchard that the scale had spread over a considerable portion of it, we recommended the remedies published in Bulletins Nos. 50 and 53, issued by the State Board of Horticulture, to be vigorously applied until the scale disappears, and also to remove the earth three or four inches deep from around the base of the tree and fill in the space with wood ashes, as it tends to discourage the scale on that portion of the tree that the spray does not always reach.

We have tried to find where and how the San José scale first came into our county, and as near as we can learn it was first imported on young trees shipped into the county about six years ago from the infected districts about San José and the central portions of the State, and has continued to come in the same manner up to the present time. This scale is feared by the fruit growers of our county very much, for its work is of such a deadly nature that it takes but a short time to destroy a fine orchard if it once gets a good start.

The cottony cushion, black scale, and codlin moth have not yet made their appearance here. We have quite a variety of forest scale which attacks the myrtle and other forest trees, of which we will try and have samples at the Fruit Growers' Convention which is to convene at the City of Fresno, November fifth. We have found the twice-stabbed ladybug and their larvæ feeding on the myrtle scale in great numbers. On some of the myrtle trees examined that had been almost entirely covered with scale, the ladybug had eaten almost every scale on the tree, and was running all over the tree hunting for more. We are of the opinion that this bug will prove to be a great scale destroyer and a good friend to the fruit grower.

On the fifteenth of October, the Commissioners met to consider the subject of quarantining against the importation of insect pests into our county, and after due deliberation the Board declared a quarantine against the importation into our county of all fruit or fruit trees, scions, cuttings, or plants infested by any insect or insects known to be injurious to fruit or fruit trees, the same to take effect on and after the first day of November, 1889.

Respectfully submitted.

A. P. CAMPTON,
Secretary.

ROHNERVILLE, HUMBOLDT COUNTY, CAL., October 26, 1889.

REPORT OF THE KERN COUNTY BOARD.

Our County Board is not a recent creation. It was organized about four years ago, but we have been so hampered by our Board of Supervisors that we have been unable to do anything until the present season. We started in four years ago with the intention of cleaning up every infected orchard in the county if it were possible to do so. We made a personal inspection of *every* orchard in the county, and found nearly every locality badly infected. Among other places we found some orchards belonging to J. B. Haggin in a bad condition. After serving the notices and then the orders to disinfect, as required by law, and Haggin's representatives paying no attention whatever to them, we proceeded to take out a warrant for the arrest of Mr. Haggin. This coming to the notice of one of Haggin's creatures, who was a member of the Board of Supervisors, and the Board being then in session, he at once attempted to abolish the Board of Horticultural Commissioners. Finding he could not do this legally, he had our allowance cut down to $1 per day, and pay our own expenses. Of course, that shut us off at once, and nothing more was done, except to appoint new Commissioners as terms expired, until last winter, when the Supervisors increased the rate of compensation to $5 per diem, and pay our own expenses. They were very late in doing this, and we had not time to do much work, but by dint of hard work we have held the scale in check, and where there was time for thorough treatment have eradicated the pest entirely.

All of our books, papers, records, and instruments were destroyed in the recent fire.

L. W. BURR,
Secretary.

November 30, 1889.

REPORT OF THE LOS ANGELES COUNTY BOARD.

With the drawbacks incidental to real estate speculation and threatened extermination by insect pests, horticultural interests in Los Angeles County for two years past have been in an apparently dormant condition. It can be safely said, however, that a new awakening is evident, and the future is very bright and hopeful for fruit growers, especially those engaged in the culture of the citrus family.

The *Icerya purchasi* has been brought to subjection by the introduction of that wonderful parasite, *Vedalia cardinalis*, and there is no longer any dread of the pest that for a time threatened to destroy every citrus fruit tree in this county.

The black scale (*Lecanium oleæ*) also has found an enemy that has kept it down throughout this territory, and in some localities caused it to entirely disappear, and with it the black fungus growth which, since the presence of this pest, has been found on the leaves and fruit, thereby preventing free respiration, and making an additional expense in the marketing of fruit. The disappearance of the black scale insect is especially noticeable in the San Gabriel Valley, more particularly about Alhambra.

In some portions of the county where attention is given to the culture of deciduous trees, the San José scale has made serious inroads, but is being kept well in hand through the efforts of the County Board of Horticultural Commissioners.

The greatest pest to be dreaded at the present is the red scale (*Aspidiotus aurantii*), to be found in and around Los Angeles and the San Gabriel Valley, and the red scale that has been so destructive to citrus trees in Orange County, and is said to have effected a lodgment in the southern part of Los Angeles City.

The County Horticultural Board is making strenuous efforts to keep this voracious pest in check, very materially aided by the twice-stabbed ladybird and the lace-wing fly. The Board has just received reports from the general inspection districts, and in those cases where the law has not been complied with as to disinfection, etc., it will be at once rigidly enforced. In the mean time with confidence in the reasonable supposition that every insect pest has a natural enemy, they will endeavor to obtain, by correspondence and otherwise, the home of this presumed parasite, and when found procure its introduction into the county, either by county or State assistance, and if this fail, hope to gain the desired end through individual efforts of the fruit growers.

Notwithstanding innumerable drawbacks encountered by the orange growers during the last three years, there is every evidence that the coming season will show a greater number of orange trees planted in the county than ever before. In many places where vineyards have yielded to disease, orange trees will take their place, and land heretofore given up to grain has had water brought to it, to be followed by plantations of young budded orange trees. There are thousands of budded trees in nurseries ready for the orchard, and at this time it is estimated four hundred thousand Navel orange trees have been contracted for, all to be set out between this and next July. Every one has taken new heart, and the prospects of a thorough, intelligent pursuit of an industry that will bring millions of dollars into the county are bright indeed.

Early rains, followed by congenial suns, have caused the oranges to ripen earlier than ever, and a short crop, withal, have brought good prices to the orchardist.

Through some mysterious agency the seedling trees generally did not flower fully, some not at all, the budded, however, bringing forth a full crop. In Los Angeles City it is estimated there will be only one tenth of a crop; south of the city, from one third to one half. In Pomona, a full crop; this locality having nearly all budded trees and these just commencing to yield a paying crop. In Duarte and Azusa, the red scale has spread badly in the last twelve months; this, with failure of seedlings to bloom, will return but two thirds of a crop. In San Gabriel, where nearly all are seedling trees, there will be only one fourth of a crop. Alhambra, that shipped last season forty-five thousand boxes of oranges, will probably not ship over half that amount this year. Pasadena's yield is reduced to one fifth; while San Fernando, where trees are just coming into bearing, is hardly necessary to estimate.

The County Board of Horticultural Commissioners are alive to the fact that great danger is imminent from new insect pests introduced into neighboring counties; also from Florida and other large orange-bearing districts, and have decided on the enforcement of a rigid quarantine against them.

Respectfully submitted.

F. EDWARD GRAY,
Secretary.

December 31, 1889.

REPORT OF THE MENDOCINO COUNTY BOARD.

This Board was appointed in January of this year. It consists of M. Baechtel, of Willits, as Chairman; C. Purdy, of Ukiah, Secretary; and C. R. Thomas, of Calpella. The first action of the Board was to district the county into three sections, and to authorize one of the Board to examine orchards, etc., in each district.

I was appointed to the southern section of the county, where the most interest was shown, and carefully examined forty or fifty orchards. I found the San José scale in eight or ten orchards. I recommended the caustic soda and potash remedy for winter use, and cutting back the tree to wash thoroughly. Owners in nearly every case followed out the recommendations.

The codlin moth I found in nearly every orchard in Ukiah and Sanel Valleys, and to some extent in Anderson Valley. Many parties scraped the trees and used the lye wash at my suggestion, but very few tested the arsenic summer washes.

The woolly aphis I found in nearly every orchard I visited, and recommended wood ashes and gas lime. Where applied, the trees showed improved health.

The pear blight I found on apples and pears at several points. I also found the red spider very frequently.

As my work did not continue later than March, I cannot speak of summer pests. Unofficially I have noticed several pests since.

In two plum orchards the fruit turned black at the pit after full grown and when beginning to ripen. All of the fruit on some trees was so affected. Ripening was arrested and the fruit worthless. I could find no insect work, but had not the time to investigate further.

My colleagues did but little. Mr. Baechtel examined but one orchard, finding the pear blight only. Mr. Thomas examined two orchards and found the codlin moth and woolly aphis.

At the April term of the Board of Supervisors our compensation was fixed at $3 per day without mileage. As our county is mountainous, of course the work cannot be done for that, and Mr. Baechtel and myself resigned. Through the votes of those Supervisors who favored the Board of Horticulture, the resignations were laid on the table, not accepted. The two Supervisors hoped to secure favorable action in the salary matter, but so far have not been able to do so, and the matter so rests.

Since our resignation Mr. Thomas has done nothing, and unless the Supervisors can be induced to fix the compensation at a reasonable amount, no work is likely to be done.

Respectfully submitted.

CARL PURDY,
Secretary.

UKIAH, CAL., October 21, 1889.

REPORT OF THE NEVADA COUNTY BOARD.

We beg leave to submit this, our first report:

On the twenty-ninth of January, 1889, the Board of Supervisors of this county issued commissions to John T. Rodda, S. N. Stranahan, and Geo. F. Beales, as a County Board of Horticultural Commissioners. Immediately on receipt of our commissions we met and organized by electing John T. Rodda, President, and Geo. F. Beales, Secretary; and divided the county into three districts, comprising the whole county.

We then inspected every orchard in our respective districts. We found but very few scale, except in Grass Valley, Nevada City, and Mooney Flat. We recommend the salt and lime remedy. It was used with good results by John T. Rodda in Grass Valley. In five days after using, trees which had been covered with scale before the application, not a living scale could be found on them. Others have used it with the same results. We had five thousand notices printed to serve on every one in the county that had an orchard infected, and we found that it saved time, and the majority of them did as recommended in the notices.

By frequently calling meetings of the Board and consulting each other, we have succeeded in getting rid of the scale in some localities and diminishing it in other portions of the county as fast as possible. The majority of the fruit growers of the county are interested in the work, and they feel confident that the horticultural interests of the county are in safe hands.

Considering that the season was well advanced before we received our appointments, we feel confident that we have done good work.

Mr. John T. Rodda is agent for the Bean spray pump, and he has done good work in and around Grass Valley. Mr. Thompson of Rough and Ready, John Rickey of Mooney Flat, and Brad. Perkins of Grass Valley, have each purchased one of these pumps, and they say they are perfection. They are spraying all the orchards in their respective districts, and the scale is decreasing.

In another year we will have a number of orchards clear of scale, and that will encourage the planting of young orchards. There are thousands of acres of splendid fruit land in Nevada County that are now lying idle for want of a market for their fruit. There is room for two or three canneries in Nevada County, and there is plenty of young wood to run the canneries with. There is now a building being erected on the premises of John T. Rodda, the nurseryman, to be used and operated as a cannery the coming season.

There have been no less than half a million young trees planted out in the last four or five years, and there is land prepared for as many more during the next year or so.

At all the places where we have found scale, it has been traced to getting trees and fruit from Sacramento, San José, Chico, and Marysville.

We have received quarantine appointments from the State Board to inspect every tree and box of fruit coming into the county, from any source whatever, and propose to enforce the law to the letter.

The mining industry has been taking the lead here, but in the near future the fruit industry will lead them, and bring large returns from money invested.

In many places in the lower part of the county young apricot orchards have yielded on an average of $250 per acre. The majority of the orchards have been sadly neglected until recently. They are waking up now and are pruning their orchards and taking care of them, which they did not do before. However, a few have been taking care of their orchards in the past and have been reaping good returns, and have been planting out more young trees each year. There is plenty of water to irrigate with at reasonable rates. The Excelsior, South Yuba, Eureka Lake, and Campbell Ditch Companies have in operation hundreds of miles of ditches, running through the entire county, including many miles of branch ditches. There is water and land enough for twenty times the present population.

Many hills barren only a few years ago, that are now planted to trees and vines and are doing well, are a cure for sore eyes to old residents who always used to say that Nevada County could not produce fruit.

All varieties of fruits are doing well; the orange and lemon are also thriving in certain parts of the county. In many localities of the county, in red alluvial soil, trees of all descriptions can be grown successfully without irrigation, olives included. What Nevada County wants is population, to make it second to none in the State.

GEORGE F. BEALES,
Secretary.

September 29, 1889.

REPORT OF THE SANTA BARBARA COUNTY BOARD.

Herewith we submit our initial report, to the end of September, 1889.

Immediately on our appointment as a Board of Horticultural Commissioners, we met in the City of Santa Barbara, and proceeded to organize by electing T. N. Snow, President, and R. Machin, Secretary, of said Board.

Having districted the county, O. W. Maulsby was appointed inspector for District No. 3, R. Machin for District No. 2, and T. N. Snow for District No. 1.

Mr. Ellwood Cooper, President of the State Board of Horticulture, very kindly met with us and gave us the benefit of his varied experience in this work; at the same time he gave us for our use an invoice of the *Vedalia cardinalis*, which he had very thoughtfully ordered in advance.

We had erected at once, for the use of the inspector of District No. 1, a large cheese cloth tent, for the propagation of the *Vedalia*, to wage a vigorous warfare against the *Icerya purchasi*, which, happily for us, is at present confined to this district. In this connection we have very great pleasure in testifying to the excellent work done by this wonderful little "ring of exterminations," viz.: the *Vedalia cardinalis*.

In the language of the Commissioner of this district, "the hides of the *Icerya purchasi* are found flapping around the trees like a line of clothes on a windy washing day." A great deal of time has been occupied solely in distributing colonies of this interesting bug for the extermination of this, the worst of pests.

The cottony cushion scale has been found on almost every species of plant in and around the fair City of Santa Barbara. Upwards of one hundred thousand fruit trees have been examined by the three Commissioners in the county, and while we candidly admit that the large growers are almost a unit in helping to eradicate all insect pests, the small growers, in a general way, show so much apathy as to cause considerable alarm. It is a self-evident fact that we shall be compelled to avail ourselves of all the power the *law* gives us to compel them to clean up.

In District No. 2, which includes the Santa Inez Valley, it is very gratifying to find a body of horticulturists so thoroughly in earnest as to keep everything clean. The olive orchards here, as well as the others, with rare exceptions of a few black scales on the olives, were in a remarkably clean condition.

A want of knowledge of the various insect pests has no doubt brought about considerable neglect. In parts of the county the *Aspidiotus perniciosus*, the San José scale, and the red spider have made considerable progress. The Commissioners are all in dead earnest in exterminating every insect pest. In Santa Maria the pepper trees, used for shade, were so badly affected with the black scale as to render it necessary to top back the trees and burn the tops.

Vigorous measures are being resorted to in every way to control the spread of all our enemies, viz.: Codlin moth, cottony cushion scale, rapax, San José scale, red spider, woolly aphis, red scale, black scale, brown scale, all of which are present in greater or less quantities.

We shall urge the Board of Supervisors to allow us to appoint an inspector for each district, whose duty it shall be to inspect every bundle or parcel of trees brought into the county, this being one of the most effective measures for controlling the spread of insect pests.

We had the pleasure of meeting Newton B. Pierce, Vegetable Pathologist, Special Agent of the Department of Agriculture, who gave us ocular demonstrations of the fact that the dreaded vine disease is within our borders.

Respectfully submitted.

ROWLAND MACHIN,
Secretary.

October 26, 1889.

REPORT OF THE SAN BERNARDINO COUNTY BOARD.

In this county each year marks a rapid advance in the horticultural industry over the former. In 1888 the area planted was so large that to supply the demand for trees, shrubs, etc., they had to be imported from almost every available quarter; and the danger of infection came to be recognized as so great that it resulted in the appointment of a County Board of Horticultural Commissioners on December 31, 1888.

Receiving our commissions, we met on January 8, 1889, for organization. We then made a hasty examination of that portion of the county chiefly devoted to horticulture, for the purpose of acquainting ourselves with the situation, and at the same time selecting responsible and active men to act as local inspectors. The plan we adopted for the latter purpose we found to work well, and would recommend it to other county Boards organizing, viz.: to call a meeting of the fruit growers of each section, and after explaining our objects and the qualifications required, have them select one of their own number for the position. By this course, too, we were able to disseminate a great deal of information on the subject; for while we found a general willingness on the part of nearly all to do whatever was considered necessary to keep their trees clean, very few were acquainted with the scales themselves. Hence our work has been largely of an educational character. We had, when making an inspection of their trees, to instruct the owners in the appearance of the different insects (for which purpose we carried specimens with us), and by means of the press and circulars to warn them of the danger and penalty of non-compliance with the requirements of the law. In this way we have succeeded in arousing an enthusiastic sentiment of self reliance and self defense that is worthy of the *banner county of citrus culture*.

We have now twenty-two local inspectors in active service, each assigned to a definite district. These we call together at intervals for report and discussion; to which meetings they bring specimens of any new insects they may have found, making a report of their observations of its habits, or of branches showing the effects of the different remedies used. It is difficult to estimate the beneficial results following this course; for, from it are the Commission not only able to keep informed of the enemies to be fought, the friends to be cultivated, and of the relative value of the different compounds recommended, but the inspectors themselves get the benefit of practical instruction, with microscopical aids, by which they are more speedily and thoroughly prepared for their work. We have now nearly completed the third examination of all trees, shrubs, etc., which has revealed the presence of a greater variety of scale insects than was supposed to exist, but none in such numbers as to cause alarm. Our motto is "Extermination and protection against further infection," and our examinations and experience has not discouraged the hope of being able to accomplish that end.

Our first examinations were necessarily hastily made and very imperfect, disclosing only black (*Lecanium olea*) and brown (*Lecanium hesperidum*) scales on the orange and lemon, and such deciduous trees as are more frequently infested with the former, and San José (*Aspidiotus perniciosus*) on the deciduous trees in some few localities. The more careful inspection, now nearly completed, has produced the following lengthy list: On orange and lemon, California stock, *Lecanium olea*, *Lecanium hesperidum*, *Aspidiotus aurantii*, *Icerya purchasi*, and *Aspidiotus perniciosus*.

Some work was done during summer on the *Lecanium olea*, but we have found best results attended spraying in September, October, and November, the exact period depending upon the condition of the eggs, *i. e.*, whether all are hatched out or not. In October of this year we found the eggs all hatched and the development of the young so slow that a much longer period is given, during which a weaker solution can be effectively used before the insect assumes its armor. One spraying with a solution of one gallon of California orchard soap to forty gallons water; or, one pound caustic soda, nine pounds resin to forty gallons water, either costing 1¼ cents per gallon of solution, produced excellent results, killing 85 to 90 per cent, while a second application practically exterminated them. The same treatment of *Lecanium hesperidum* was followed with the same satisfactory results.

On the few cases of *Aspidiotus aurantii* we had, we can say positively that the trees were brought from nurseries near Santa Ana or San Gabriel. The course of treatment we have invariably urged has been to cut back and defoliate the tree so it could be thoroughly scrubbed with the resin solution given above, and following it up at intervals with two or three sprayings; and at the same time to spray all the surrounding trees once or twice. In only one case, and in that the work was not well done, has there been a reappearance of the scale. In two or three cases the owners demurred to this course, and preferred to rely on repeated spraying. In each the scale has increased, and the trees have made no growth, and now they have consented to adopt our recommendations. If extermination is aimed at we have no hesitation in saying that the former is the better and cheaper course in the end, if faithfully done, as the tree will sooner return to bearing. Repeated spraying checks the growth and otherwise injures the tree, particularly with resin compounds, and will not exterminate the scale.

Icerya purchasi was discovered twice on shrubs intended for planting and once on a bouquet, all brought from Los Angeles. They were immediately burned with the earth and packages containing them by the local inspectors. Aside from these, it was found in two localities, and, so far as we can judge, must have been brought there by birds, as there is none known nearer than thirty miles. The orange tree in one case and some shrubs in the other were dug out and burned, the premises kept under the constant supervision of two inspectors, and nothing of it now remains.

We have had one case of *Aspidiotus perniciosus* on an orange tree, which, however, yielded readily to a treatment of the resin compound.

We have also had one case of termites and two cases of black ants at the roots of orange trees. The latter were very persistent, and yielded slowly to repeated applications of Ongarth's powder, after buhach and boiling water had failed

ON ORANGE AND LEMON—FLORIDA STOCK.

We have found chaff, long, purple, *Lecanium olea*, *Lecanium hesperidum*, and white wax scales on the trees imported, the frequency occurring in the order named. All the trees were dipped in either kerosene emulsion or a solution of corrosive sublimate, and the *Lecanium hesperidum* is the only one found on the trees after planting.

ON DECIDUOUS TREES AND SHRUBS.

We have found *Aspidiotus perniciosus* on pear, apple, prune, peach, plum, almond, Texas umbrella, and apricot; *Lecanium olea* on olive, oleander, apricot, pepper, and pear; walnut scale on walnut, pear, and apple; oleander scale on oleander; rose scale on roses; blackberry scale on blackberries; *Aspidiotus aurantii* on roses; *Lecanium hesperidum* on fig; white grape on grape, and a species of *Aleurodes* on acacia.

Of the four latter only one case each existed, which have yielded to the remedies applied. Nor are the rose and blackberry scales prevalent, only a very few cases being found. The *Lecanium olea* and oleander scales have received the same treatment as on the citrus trees, with about the same results. On the walnut scale, we have used concentrated lye with good results.

The *Aspidiotus perniciosus* is much more difficult to treat satisfactorily, and our orchardists in many instances have attached so little value to the trees that they have dug them out rather than incur the expense of cleaning them. In some sections, however, they have preferred to make the attempt. In the spring we used concentrated lye in the proportion of one pound to one to three gallons of water, with beneficial results. The trees were much invigorated, a healthy growth was made, and a fair crop of fruit secured. As a winter wash we propose using principally the salt and lime remedy recommended by Mr. Thomas, on page 22 of bulletin No. 50. With the resin wash the chief difficulty we have had to encounter is to get the orchardist to realize the importance of its preparation.

We anticipate the same trouble in the use of the salt and lime remedy, as well as in any other that requires boiling for any length of time, as few, if any, are supplied with the necessary utensils or possess the requisite knowledge or experience. To meet this, we detail a local inspector to superintend the preparation and application. Wherever undertaken without this supervision the results have been indifferent.

We have found it very difficult to determine the best period in which to spray, owing to the almost continuous hatching of the eggs of most varieties of scales in our climate. At this time, November thirtieth, the eggs of the *Aspidiotus aurantii* and *Aspidiotus perniciosus* are hatching in large numbers, which fact renders our task still more difficult.

Of parasites, we have observed only the lace-wing fly, the twice-stabbed ladybug, and the common ladybug, and their work has been confined to *Lecanium olea*, *Lecanium hesperidum*, and *Aspidiotus perniciosus*.

We are convinced, however, from our experience here and observations elsewhere, that the insects, particularly those infesting citrus trees, for some cause we cannot fully explain, unless it be our dry atmosphere, do not multiply as rapidly as nearer the coast.

Our labors have also extended to a rigid examination and disinfection of all classes of stock brought in from other sections for planting. Over three hundred thousand orange trees from Florida alone were disinfected by dipping, last spring. Every avenue has been as carefully watched as possible, to prevent the further introduction of pests. To-day, our greatest danger of infection is from shrubbery and ornamental stock being brought or shipped in from Los Angeles and the northern portion of the State, and from the peddling of infested fruits from Los Angeles and Orange Counties among our merchants and ranchers.

In conclusion, we append a schedule of the acreage and number of trees of various kinds of fruits which we have compiled from the reports of our local inspectors, in order to give you a better idea of the extent of our work and of the value of the horticultural interests of this county:

KIND OF TREES.	Acres.	No. of Trees.
Peach	1,942	206,078
Pear	415	44,861
Apricot	1,346¾	130,521
Apple	172	15,222
Almond	8	817
Fig	145½	8,567
Cherry	12	1,297
Walnut	164¼	7,222
Chestnut	1	40
Olive	118¾	11,224
Guava	2	1,000
Prune	239¾	23,455
Plum	1¼	128
Blackberry	31	------------
Strawberry	40	------------
Raisin grape	3,778¼	------------
Wine grape	2,047½	------------
Lemon, planted four years and over	281	24,066
Lemon, planted three years and under	89½	7,009
Orange, planted four years and over	4,347	391,656
Orange, planted three years and under	5,828	472,826
Grand total	21,008½	1,345,989

There are now in nurseries and ready for market:

In 1890	426,356 orange and 75,000 lemon.
In 1891	591,973 orange and 50,000 lemon.
In seed beds for budding	2,526,150 orange and 50,000 lemon.

On the basis of assessed valuation the fruit lands of the county, with their improvements, form $91\frac{1}{10}$ per cent of the total value of real and personal property, or $77\frac{1}{10}$ per cent of the total valuation of the county, including railroads. The rapid strides by which it has advanced in fruit culture can best be comprehended by a careful study of the above figures; one feature to be noticed being the proportion citrus culture bears to the whole.

All of which is respectfully submitted.

W. E. COLLINS,
Secretary.

November 30, 1889.

REPORT OF THE SAN BENITO COUNTY BOARD.

The Board of Horticultural Commissioners of San Benito County beg leave to report as follows:

The Commission was appointed as provided by law, in July of this year. It consists of E. W. Bowman, San Juan, as Chairman; G. Brown, Hollister; and J. A. Scholefield, Hollister, Secretary.

The County of San Benito has been in a measure neglected or overlooked by prospective fruit growers, owing largely to a lesser rainfall than other portions of our favored State. However, it contains a goodly number of orchards which produce paying crops of first class fruits. The soil of a large portion of the valley lands is sediment, with an admirable subsoil, nicely adapted to the raising of fruit. Some of the rolling land produces good tree growth and splendid fruit.

The Gabilan hills contain in places excellent soil for fruit and vines, and fruit ranches, large and small, begin to dot the whole range. The soil is largely composed of decomposed granite, covered by a thick vegetable mold, unsurpassed in richness. These hills will in time contain many happy homes.

The noted places in these hills are the orchards of Hon. Thos. Flint, containing twelve or fifteen thousand trees of various fruits.

An extensive drying plant was established here some years ago, and the product of the orchard is prepared for market at home, and shipped to various points in the East.

The largest orchard in the valley portion of the county is owned by the Bonnie Brae Company. The property contains fifteen thousand trees of staple fruits, planted in the winter of 1888; have made a wonderful growth, and are free from disease or insect pests.

There are very many small orchards here which need mention, notably among these is the one of E. W. Bowman, who has entered into this business with a stout heart and brawny arm, has succeeded beyond expectations, and has amply demonstrated that in and around San Juan, even on rolling land, first class fruits can be raised.

The orchards of Mr. Chas. Straube, George Lyman, and many others, prove conclusively that honest effort will be well rewarded in fruit culture here as elsewhere.

The Commission, duly armed with certificates as Quarantine Guardians, made a very searching examination of orchards in different localities, and beg to report as follows:

The codlin moth (*Carpocapsa pomonella*) is everywhere present, here as elsewhere, but wherever the London purple remedy has been intelligently applied most satisfactory results have been achieved.

Mr. Floyd, spraying his five-year old apple trees twice, obtained from six hundred trees four hundred boxes of marketable fruit. Mr. F. A. Cunning, from his orchard with two sprayings, from a similar number of trees, but older, about one thousand boxes, one fourth of which were punctured by the moth. Others report similiar results.

We feel confident that when this remedy is universally applied the ravages of this destructive insect will in time be overcome. The San José scale is also present here, but wherever standard remedies have been applied success has been obtained.

The brown apricot scale has also been discovered here, and will be closely looked after, to prevent their spreading. The red scale has been discovered here on a few citrus trees, but has been successfully combated with a private remedy, which will, in due time, be made public.

No cottony cushion scale have as yet been discovered here, but a close watch is being kept. Woolly aphis are troubling apple trees here to a considerable extent, but efforts are being made to annihilate them if possible.

Borers are present to some extent, but will be closely looked after. On the whole, horticultural interests are flourishing fairly here.

A horticultural society is being formed here to work in conjunction with the Board of Commissioners, thereby facilitating the labors of the latter.

The planting of the coming season promises to be of fair proportion, and all nursery stock shipped in here, from whatever direction, will be closely inspected, and such as is found to be infested will be returned or destroyed.

We beg to assure you, gentlemen of the State Board, that the laws relating to our industry will be intelligently carried out, and the horticultural interests watched and fostered as the law provides.

Respectfully submitted.

JOHN A. SCHOLEFIELD,
Secretary.

October 23, 1889.

REPORT OF THE SAN JOAQUIN COUNTY BOARD.

The old Board of Commissioners of this county sent in their resignations to the Board of Supervisors on March 31, 1889, with a request that they should appoint their successors as soon as possible, consistent with the public welfare and the best interests of the fruit growers of this county. This course was adopted to obviate any difficulty, should a question arise as to the legal status of the Commission, and its powers and duties under the amended Act. Unfortunately for the horticultural interests of the county, and the success of the labors of the Commission during the current year, the appointment of a new Board was delayed six weeks at the most critical period of the growing season, and until the fruit crop was at such an advanced stage as to preclude the use of any but the simplest summer washes.

The new Commission is composed of Joseph Hale, President (two years); Wilber S. Allen (one year); Wm. H. Robinson, Secretary (three years); and George W. Wise, Lockeford, Quarantine Guardian. It was duly organized May 14, 1889, by the election of the above named officers, and the regular meetings fixed for the last Monday of each month. In consequence of the lateness of the season it decided only to recommend the Woodbury tree wash as a safe, cheap, and effective summer wash, when used in the proportion of ten or twelve gallons of water to one of the wash; it is always ready for use; people cannot make mistakes in preparing or using it, and in these proportions it is not injurious to tree or fruit. Care, however, must be taken never to spray during the prevalence of north winds, long continued observation of its effects having demonstrated that the practice is injurious to fruit at such times. For fall and winter use, the lime, sulphur, and salt preparation—State Board formula—has given general satisfaction whenever used, and is recommended in preference to any other remedy. We consider the Bean automatic spray pump the best now in use, and the only one fit to use with acid insecticides.

Experiments made in pruning apricots in August, immediately after removal of crop, and in February while the trees were still dormant, all on same variety and same soil, standing alongside each other, and receiving the same care and cultivation, were reported to the Board; and as the result, those pruned in August blossomed ten days earlier and ripened two weeks sooner. The late sap that formed wood in the next season's growth of the February pruned trees, produced more fruit spurs in the August pruning; crop of fruit larger, and the heads made a more uniform and compact growth.

San Joaquin County claims about nine hundred thousand acres within its boundaries, and nearly the whole of this immense area can be converted into the best tillable land in the State—almost every acre suitable for fruit growing in all its varieties.

The simple inspection and location of infested orchards in this vast territory is a work of magnitude, involving the expenditure of much time and travel in its accomplishment. In this endeavor the Commissioners have visited many orchards on both sides of the Mokelumne River, near Clements, Lockeford, Acampo, Lodi, and Woodbridge, and held numerous consultations with the fruit growers upon the best methods to be adopted to prevent the spread of insect pests. Other sections of the county will receive attention later in the season, and it is hoped with better results.

The young orchards planted within the past two or three years were almost, without exception, in a healthy, thriving condition, free from scale and other insect pests; the trees pruned to low heads, and the land clean and well cultivated, showing care, skill, and good judgment in their treatment, in marked contrast to the old orchards, which invariably showed the entire absence of all those important elements of successful culture. The latter were unpruned, and trunks and limbs covered with rough, moss-grown bark, in most instances composed of masses of dead or dying wood, and their unsightly branches almost hidden from sight by loathsome myriads of San José scale, red spider, and woolly aphis; the foliage distorted by curled leaf, green aphis, and shot-hole fungus; and the fruit showing the presence or ravages of scale, codlin moth, and the above named fungus. These old orchards are a perpetual menace to the prosperity of this great and growing industry, and they should be severely pruned and disinfected, or, better still, destroyed root and branch without a moment's hesitation, before they can infect the young orchards in their neighborhood.

Wagons and boats bring fruit into this market and the stores and stands at which it is sold have also received the constant inspection and careful supervision of the Board. This has been found the most feasible plan by which to locate orchards infected, and obtain a list of the names of the owners or renters, so that notices should be served upon them at the close of the season to disinfect. In this way we have secured positive knowledge of the pests infecting certain localities, and can act with a thorough understanding of the circumstances surrounding each case.

Stockton is surrounded by vast bodies of rich land, especially adapted to fruit growing, and great vigilance should be exercised in endeavoring to keep the gardens and orchards free from diseases and pests in all their forms. We are sorry that a proper regard for the truth compels us to report a very different state of affairs, and that careful inspection shows almost every yard and garden within the city limits, where a fruit tree has been planted, to be infected; and that many of the very worst cases can be found in small lots containing a few trees, the fruit from which is suffered to rot on the ground where it falls, and which thus become breeding places from which the pests are scattered broadcast throughout the county. In nearly every case the primary cause can be traced to empty fruit boxes left lying around the yards, instead of being destroyed immediately after emptying them. We noticed among the most prevalent, San José scale, cottony cushion scale, red orange scale, black scale, woolly aphis, and codlin moth; enough surely to alarm the most indifferent among those who contemplate pursuing this industry as a means of making a livelihood.

We are gratified to be able to report that great interest has been developed in relation to these matters by the circulation of the valuable reports and bulletins published by the State Board of Horticulture, and that the opportunities afforded by our visits of inspection to discuss methods of planting, cultivating, pruning, and disinfecting fruit trees are eagerly embraced by the fruit growers in those portions of the county recently visited. By many these visits are converted into object lessons, and being their first introduction to the mysteries enshrouding insect life, they become to them a veritable revelation. Nearly all expressed themselves as much pleased with the reorganization of the Commission, and promised, when the proper time came, to coöperate heartily with the Board in its efforts to enforce the law. The dissatisfied ones have complained, because the San Joaquin Commissioners are apparently alone in attempting to conform to the requirements of the amended Act, in condemning infected fruit brought to our local market, while the same found ready sale in San Francisco, and the dealers there openly defy and disregard it. The bugs have come to stay, and we shall always have to fight them in future.

Among other things noted, we call attention to the fact that the persons in charge of the fruit exhibits at the State and district fairs, placed on the tables fruit pitted and spotted with marks, showing the presence of scale, which, in itself, ought to have barred their entrance, and certainly should deprive them of any chance of competing for premiums in the opinion of competent judges in such matters.

Respectfully submitted.

WM. H. ROBINSON,
Secretary.

STOCKTON, October 18, 1889.

REPORT OF THE SAN MATEO COUNTY BOARD.

San Mateo County is notably a dairying county, with the production of considerable hay and grain for the market in addition to dairy products. It has not been distinguished in the horticultural line, except in floral and ornamental growths among the wealthy residents in or near the railroad towns. Fruit growing, however, has been rapidly on the increase within the last three or four years.

When the Horticultural Commissioners were appointed, about two and a half years ago, the work before us seemed of a very discouraging character. Insect pests were very abundant. Very few cultivators knew much about them. They knew that their apples and pears were wormy, but scarcely any one knew anything about the insect that caused the damage, its character, habits, mode of work, or of the means for combating them.

CODLIN MOTH.

At this time, nearly every orchard grower is well informed about the codlin moth. On examining fruit houses many hundreds of cocoons of the codlin moth were found, occupying every crack and crevice, and sometimes many of the moths flying about. Such houses have been cleansed or abandoned. Fallen wormy fruit has been gathered and fed out or destroyed. Bands have been placed on the trees, and where attended to thoroughly have been very successful. In one orchard (Wm. Corbett's), where the fallen fruit is regularly gathered and fed to hogs every two or three days, there is certainly less of the codlin moth than in any other orchard within half a dozen miles of it, and the trees were not banded.

In Eastern States, the banding system, with destroying the wormy fruit, has been practiced for more than a quarter of a century, and it has been estimated that by that plan 80 per cent of the codlin moth can be destroyed. It is believed that no other plan will yield as good results. In this county trial has been made with the arsenites—London purple or Paris green—for spraying, but the result has not been satisfactory. It is only applicable really to the first brood of the codlin moth, and is imperfect for that. It has been said that in this State there are three broods of the insect. This may be doubtful, but is not improbable. After the tiny, little, yellow egg is deposited in the blossom, or calyx, by the female moth, several days over a month will be required for the worm to attain its full growth; then, when it emerges, three to five days will be required for it to seek a suitable crevice and make its cocoon. Then two weeks more will elapse before the moth is prepared to leave the chrysalis, seek its companion, and prepare for laying eggs. This will carry the time nearly or quite to the first of July. The second brood not infrequently deposits the egg on the surface of the fruit. Often two or three worms of different sizes are found in the same apple, showing that the broods run into each other. All the worms that spin up as late as September remain in the larval state until next April, when they change into chrysalis nearly at the same time. They seem to have a very long sleep, over half the year, and yet they do not sleep very soundly, for if you cut a hole in the cocoon they go to work and wind it up, and will do this more than once.

Many people do not care to have their fruit sprayed with arsenical solutions at any time, and certainly not after the fruit is half grown or more. The banding plan, thoroughly followed, with destruction of the fallen fruit, has the preference in this locality. The codlin moth was not known on the coast side of the county until last year. They were supposed to have been brought in by fruit peddlers from infected districts. Such fruit peddlers have now been forbidden by the Commissioner of that district.

WOOLLY APHIS.

This little pest exists in nearly all the apple orchards of the county. It has been called "woolly plant louse," and "apple root plant louse." It is a more serious pest than most people are aware of. Many owners of orchards have taken pains to clean them off from the trunks of trees, and also from the limbs and sprouts of trees, without knowing or realizing that the most destructive work is done upon the roots of the trees. They suck the sap out of the roots, especially the fibrous roots, which are the life of the tree; the roots become a mass of knobs, knots, and contortions, the growth of the tree is checked, and at length it dies.

Those having old orchards badly infested with these lice have been advised to plant new orchards and to destroy the old ones.

A very important matter in planting apple trees is to be sure they are not infested with the woolly aphis, especially upon the roots.

COTTONY CUSHION SCALE.

The eastern or bar coast side of the county, from Millbrae to Menlo Park, has been very badly infested with the cottony cushion scale. Thousands of trees have been cut down and destroyed in consequence of it. Last spring Mr. Albert Keobele, an entomologist in the employ of the Department of Agriculture, brought to San Mateo a few of the Australian ladybirds (*Vedalia cardinalis*), and they were planted on the badly infested grounds of Mrs. H. P. Bowie. A short time afterwards, Secretary Lelong, of the State Board of Horticulture, came here with another quota of the Australians, which were put on the same place. Later still, Mr. Lelong sent another quantity, which were deposited in other localities. These Australian parasites were closely watched, and as they were evidently doing good service colonies were taken and established in other parts of the valley where they were needed, until now almost every infested portion of the district has some of them, and more are being distributed as fast as convenient. On the Bowie place where they were first planted, it is now difficult to find a live cottony cushion scale.

Black Scale is quite abundant upon oleander and various other ornamental shrubs, upon orange trees, apricot trees, and on olive trees in several localities. Very little has been done to check their increase.

Twig Borer.—A twig borer has been noticed this year, for the first time in this locality, on olive trees. If it increases it is likely to prove a serious pest, and another year some remedy may be needed.

Striped Beetle.—About midsummer, Mr. A. Borel, of San Mateo, who owns a mountain ranch not far from the southern boundary of the county, complained that there was a little bug on the ranch that was eating up almost every green thing. They proved to be the striped cucumber beetle (*Diabrotica vittata*), well known in eastern States. The foreman wrote that they were very destructive and would eat up a garden in three days. It is true that these beetles when they become very numerous, as they do sometimes in limited localities, will eat almost anything green, even to the leaves of fruit trees. The remedy that has been tried is to set out pans of water with a burning lamp in the middle. The light attracts the beetles, and the water catches a great many of them. Probably spraying with an emulsion of soap and coal oil would be quite efficient.

The fruit growing of this county is chiefly, thus far, on the bay side of the coast range of hills. The foothills and foothill valleys are quite superior for fruits of all varieties. At Woodside and Searsville, especially, all varieties, small and large, succeed admirably. At Belmont a large acreage has been planted in fruit within the past two years. As fine apples as can be grown anywhere are produced in what may be termed the fog belt: at Colma and Baden in the north end of the county, and at Pescadero in the south end. Alexander Moore, at the latter place, reports that he finds fruit trees healthy in the fog belt. Apples, pears, plums, and prunes do well. Cherries good in some localities; peaches not sure. Small fruits do well. Fruit ripens much later there than on the bay side of the county.

There is undoubtedly a large area of this county especially well adapted to apple growing, where apples of the finest appearance and of good keeping quality can be grown. The whole of what may be called the fog belt is considerably cooler in temperature and has a greater rainfall than the bay side of the county. At Lake Pilarcitos the rainfall is at least double that of places along the bay. The fogs yield considerable moisture and greatly modify the summer heat. The soil on top of the mountains on elevated plateaus, on the foothills, and in the small valleys is generally deep and good. The people occupying these lands have, generally, little knowledge of fruit growing and care nothing for it. Large numbers of them have never planted trees on their lands. The time must surely come when this admirable apple-growing region will be developed, and we will then have less occasion to import Oregon apples.

Our Board consists of W. J. McNulty, President, Woodside; Alex. Moore, Pescadero; L. D. Morse, Secretary, San Mateo.

Respectfully submitted.

L. D. MORSE,
Secretary.

November 2, 1889.

REPORT OF THE SUTTER COUNTY BOARD.

On the fourth day of the present month the Board of Supervisors appointed a Board of County Horticultural Commissioners, and fixed the compensation at $3 per day; and on the sixteenth of the month the Commissioners organized by the election of R. C. Kells, President, and H. P. Stabler, Secretary.

We find that the Commission has a great deal of hard work before it in this county.

San José scale, red spider, woolly aphis, and codlin moth exist in all parts of the county. With possibly one or two exceptions, the most extensive fruit growers have been fighting these pests since 1885, with more or less success; but by far the greater number of small growers have done absolutely nothing toward the extermination of these pests.

Along the Feather and Sacramento Rivers in this county there are many small orchards, and as the owners receive their incomes from other sources than their fruit trees, little or no attention has been given to the extermination of the pests.

Our Commission has decided to reach these parties by first informing them by a circular of the appointment of, and duties of, the Commission; then by the judicious distribution of the valuable reports of your Board, and by publishing washes, etc., in the county press, and lastly, by personal visits to the infested orchards.

We hope by these means to accomplish a great deal of good before the opening of the next fruit season.

In order to prevent the importation of pests, especially scale, on nursery stock, we have addressed a circular to nurserymen, requesting them to thoroughly disinfect all stock sent to Sutter County the coming season.

We will have all nursery stock, imported into the county the coming season, inspected before the same is planted.

The existence of a flourishing Horticultural Society of forty-five members in our midst, where regular meetings are held and prominent horticulturists from abroad are frequently present, is a great help to the Commission in its efforts to reduce the pests.

Respectfully submitted.

H. P. STABLER,
Secretary.

September 9, 1889.

REPORT OF THE VENTURA COUNTY BOARD.

I herewith submit to your honorable body this report of the Horticultural Commissioners of Ventura County:

On February 1, 1886, J. A. Day, M. E. Isham, and N. W. Blanchard were appointed by the Board of Supervisors as Horticultural Commissioners of Ventura County.

We organized as a Board February 27, 1886, and since that time we have done our best to take care of the fruit interests of the county.

Twice during this time the cottony cushion or fluted scale has been brought into the county on young trees; did not make its appearance for several months after the trees were put into the ground. When we first found it we burned up every tree we found it on, and by inspecting the orchards regularly for several months, and using the same remedy, we entirely eradicated that pest.

We inspect nearly all the fruit trees brought into the county before they are set out, and afterwards when we think it necessary.

The red scale is not in the county, and has never made its appearance, except on oranges brought into the county from San Francisco or Los Angeles, which have been confiscated and destroyed, or returned to the parties from whom they were bought.

The woolly aphis is the worst pest we have at present. It is very bad on some of the old apple trees.

The black scale is very bad near the coast, but only a few miles back the trees are entirely free from it.

The codlin moth has never made its appearance here.

We have found the red spider in some places; also a very little of the greedy scale.

I think I am justified in saying that our county is comparatively clean from insect pests. The fruit crop of the county has been very light this year, especially the deciduous fruits, except apples and pears, which are a fair average crop. Oranges and lemons are doing well.

Mr. Blanchard's orange orchard in Santa Paula is the only large orchard in bearing in the county at present.

A great many citrus trees have been set out in the last year. They do well a few miles back from the coast.

There is a small orange orchard in the Ojai Valley that produces excellent fruit.

Walnuts are doing well, and at present a great many are being set out.

Respectfully submitted.

M. E. ISHAM,
Secretary.

September 28, 1889.

XXXVI.

ROSTER OF OFFICERS

OF NATIONAL, STATE, COUNTY, AND IMPORTANT HORTICULTURAL AND KINDRED SOCIETIES FOR THE YEAR 1889.

American Horticultural Society.

Hon. Parker Earle, President............Cobden, Illinois.
W. H. Ragan, Secretary............Greencastle, Indiana.

American Pomological Society.

Hon. P. J. Berckmans, President............Augusta, Georgia.
C. W. Garfield, Secretary............Grand Rapids, Michigan.

American Forestry Congress.

Hon. G. W. Minier, President............Minier, Illinois.
B. E. Fernow, Secretary............Washington, D. C.

American Association of Nurserymen.

George A. Sweet, President............Dansville, New York.
Charles A. Green, Secretary............Rochester, New York.

American Florists Society.

J. M. Jordan, President............St. Louis, Missouri.
Edwin Lonsdale, Secretary............Philadelphia, Pennsylvania.

Arkansas State Horticultural Society.

E. F. Babcock, President............Little Rock.
M. W. Manville, Secretary............Alexander.

Colorado State Horticultural Society.

E. Faurot, President............Golden.
Alex. Shaw, Secretary............Denver.

Colorado State Horticultural and Forestry Association.

C. S. Faurot, President............Boulder.
Alex. Shaw, Secretary............Denver.

Florida Fruit Growers Association.

D. Redmond, President............Jacksonville.
D. H. Elliott, Secretary............Jacksonville.

Georgia State Horticultural Society.

P. J. Berckmans, President............Augusta.
T. L. Kinsey, Secretary............Savannah.

Indiana State Horticultural Society.

Allen Fuvuous, President............Danville.
C. M. Hobbs, Secretary............Bridgeport.

Illinois State Horticultural Society.

H. M. Dunlap, President............Savoy.
A. C. Hammond, Secretary............Warsaw.

Iowa State Horticultural Society.

C. G. Patton, President............Charles City.
George Van Houton, Secretary............Lenox.

Kansas State Horticultural Society.

George Y. Johnson, President............Lawrence.
G. C. Brackett, Secretary............Lawrence.

Kentucky State Horticultural Society.

A. P. Farnsley, President............Louisville.
William Hawes, Secretary............Buchel.

Massachusetts State Horticultural Society.

Henry P. Walcott, President............Cambridge.
Robert Manning, Secretary............Salem.

Maine State Pomological Society.

Charles S. Pope, President............Manchester.
D. H. Knowlton, Secretary............Farmington.

Minnesota State Horticultural Society.

Wyman Elliot, President............Minneapolis.
S. D. Hillman, Secretary............Minneapolis.

Mississippi State Horticultural Society.

Dr. H. E. McKay, President............Madison Station.
J. E. Tevoy, Secretary............Crystal Springs.

Michigan State Horticultural Society.

T. T. Lyon, President............South Haven.
E. C. Reid, Secretary............Allegan.

Missouri State Horticultural Society.

J. C. Evans, President............Harlem.
L. A. Goodman, Secretary............Westport.

Nebraska State Horticultural Society.

W. F. Taylor, President............Omaha.
G. J. Carpenter, Secretary............Fairbury.

Ohio State Horticultural Society.

George W. Campbell, President............Delaware.
W. W. Farnsworth, Secretary............Waterville.

South Carolina State Horticultural Society.

H. B. Buist, President............Greenville.
W. C. Clark, Secretary............Columbia.

Texas State Horticultural Association.

W. G. Veal, President............Fort Worth.
T. L. Brunk, Secretary............College Station.

Texas State Nurserymen's Association.

E. W. Kirtpatrick, President............McKinney.
J. M. Howell, Secretary............Dallas.

Wisconsin State Horticultural Association.

J. M. Smith, President............Green Bay.
B. S. Hoxie, Secretary............Evansville.

West Tennessee Horticultural Society.

W. N. Harris, President............Humboldt.
R. J. Williams, Secretary............Henderson.

North Colorado Horticultural Society.

J. S. McClelland, President............Fort Collins.
J. E. Washburn, Secretary............Loveland.

Western New York Horticultural Society.

Patrick Barry, President............Rochester.
P. C. Reynolds, Secretary............Rochester.

Western Iowa Horticultural Society.

S. W. Wilson, President............Atlantic.
George Van Houton, Secretary............Lenox.

New Orleans Horticultural Society.

C. W. Eichling, President............New Orleans.
Charles Wiso, Secretary............New Orleans.

Norfolk (Virginia) Horticultural and Pomological Society.

G. F. B. Leighton, President .... Norfolk.
Colonel J. Richard Lewellen, Secretary .... Norfolk.

Western Michigan Fruit Growers Association.

Walter Phillips, President .... Grand Haven.
A. J. Knisley, Secretary .... Benton Harbor.

Abbotsford (Quebec) Fruit Growers Association.

Charles Gibb, President .... Abbotsford.
George Fisk, Secretary .... Abbotsford.

Montreal (Quebec) Horticultural Society.

Professor D. P. Penhallow, President .... Montreal.
W. W. Dunlop, Secretary .... Montreal.

Nova Scotia Fruit Growers Association.

Henry Chipman, President .... Grand Pré, N. S.
C. H. R. Starr, Secretary .... Port Williams.

Fruit Growers Association of Ontario.

Alex. McD. Allen, President .... Goderich.
L. Woolonton, Secretary .... Grimsby.

Gulf States Fruit Growers Association.

H. W. L. Lewis, President .... Osyka, Missouri.
S. M. Wiggins, Secretary .... New Orleans.

STATE AND COUNTY ORGANIZATIONS, 1889.

*California State Horticultural Society.**

(Meets at the office of the State Board of Viticulture last Friday of each month.)
Professor E. W. Hilgard, President .... Berkeley.
E. J. Wickson, Secretary .... Berkeley.

*California State Floral Society.**

(Meets at Irving Hall, on Post Street, second Friday of each month.)
E. J. Wickson, President .... Berkeley.
E. E. Smith, Secretary .... San Francisco.

Colusa County Horticultural Society.

L. F. Moulton, President .... Colusa.
Frank W. Willis, Secretary .... Colusa.

Butte County Horticultural Society.

E. T. Reynolds, President .... Chico.
G. M. Gray, Secretary .... Chico.

Los Angeles County Pomological Society.

Harrison Fuller, President .... Los Angeles.
D. Edson Smith, Secretary .... Santa Ana.

San Diego County Horticultural Society.

J. M. Asher, President .... San Diego.
Geo. H. Bower, Secretary .... San Diego.

San Joaquin County Horticultural Society.

Ezra Fiske, President .... Stockton.
W. H. Robinson, Secretary .... Stockton.

Santa Barbara County Horticultural Society.

Professor H. C. Ford, President .... Santa Barbara.
H. K. Bradbury, Secretary .... Santa Barbara.

---

* Called "State," but are such only in name.

Santa Clara County Horticultural Society.

I. A. Wilcox, President .... Santa Clara.
H. A. Brainard, Secretary .... San José.

Sonoma County Horticultural Society.

Mark L. McDonald, President .... Santa Rosa.
A. F. White, Secretary .... Santa Rosa.

Sutter County Horticultural Society.

R. C. Kells, President .... Yuba City.
H. P. Stabler, Secretary and Entomologist .... Yuba City.

HORTICULTURAL COMMISSIONS.

Alameda County Horticultural Commission.

A. D. Pryal, President .... Temescal.
A. P. Crane, Secretary .... San Lorenzo.

Butte County Horticultural Commission.

C. J. Berry, President .... Biggs.
G. M. Gray, Secretary .... Chico.

Colusa County Horticultural Commission.

J. R. Totman, President .... Colusa.
Frank W. Willis, Secretary .... Colusa.

El Dorado County Horticultural Commission.

J. H. Thomas, President .... Coloma.
R. P. Patterson, Secretary .... Placerville.

Humboldt County Horticultural Commission.

J. D. Barber, President .... Rohnerville.
A. P. Campton, Secretary .... Rohnerville.

Kern County Horticultural Commission.

M. Wyatt, President .... Bakersfield.
L. W. Burr, Secretary .... Bakersfield.

Los Angeles County Horticultural Commission.

A. F. Kercheval, President .... Los Angeles.
F. Edward Gray, Secretary .... Alhambra.

Mendocino County Horticultural Commission.

C. R. Thomas, President .... Ukiah.
Carl Purdy, Secretary .... Ukiah.

Nevada County Horticultural Commission.

John Rodda, President .... Grass Valley.
Geo. Beales, Secretary .... Rough and Ready.

Orange County Horticultural Commission.

H. Hamilton, President .... Orange.
S. W. Preble, Secretary .... Tustin City.

San Benito County Horticultural Commission.

G. Brown, President .... Hollister.
J. A. Schofield, Secretary .... Hollister.

San Bernardino County Horticultural Commission.

H. B. Muscott, President .... Santa Barbara.
W. E. Collins, Secretary .... Ontario.

San Joaquin County Horticultural Commission.

Joseph Hale, President .... Stockton.
W. H. Robinson, Secretary .... Stockton.

San Mateo County Horticultural Commission.

Wm. J. McNulty, President	Woodside.
Dr. L. D. Morse, Secretary	San Mateo.

Santa Barbara Horticultural Commission.

T. N. Snow, President	Santa Barbara.
O. W. Maulsby, Secretary	Santa Maria.

Sonoma County Horticultural Commission.

John M. Balhache, President	Healdsburg.
E. A. Rogers, Secretary	Santa Rosa.

Sutter County Horticultural Commission.

R. C. Kells, President	Yuba City.
H. P. Stabler, Secretary	Yuba City.

Tulare County Horticultural Commission.

J. N. Wright, President	Visalia.
I. H. Thomas, Secretary	Visalia.

Ventura County Horticultural Commission.

N. W. Blanchard, President	Santa Paula.
M. E. Isham, Secretary	San Buenaventura.

Yuba County Horticultural Commission.

G. W. Harney, President	Marysville.
F. W. Johnson, Secretary	Marysville.

GLOSSARY.

ENTOMOLOGY.

Acuminate—Ending in a prolonged point.
Anastomosing—Inosculating or running into each other like veins.
Annulate—When a leg, antenna, etc., is surrounded by narrow rings of a different color.
Apodous—Footless.
Areolate—Furnished with small areas; like a net work.
Aristate—Furnished with a hair.
Aurelia—Ancient term for pupa.

Blastoderm—The primitive skin of the embryo.
Blastodermic cells—The cells forming the blastoderm.
Bullate—Blistered.

Calcarated—Armed with spurs.
Cancellate—Crossed by lines going at right angles to each other.
Capitate—Ending in a knob.
Carina—An elevated keel-like ridge.
Carpus—The pterostigma.
Cellule—A little space surrounded by veins on the wing.
Chela—Terminal portion of a foot, with a movable lateral toe, like the claw of a crab or mandibles of arachnids.
Chrysalis—The pupa of Lepidoptera.
Concolorous—Of the same color with another part.
Ciliate—Fringed.
Cinereous—Ash color; color of wood ashes.
Cingula—A colored band.
Clavate—Club shaped.
Coarctate—Contracted; campact.

Confluent—Running into each other.
Connate—United.
Cordate—Heart-shaped.
Coriaceous—Leather-like, thick, tough, and somewhat rigid.
Corneous—Of a horny substance; resembling horn.
Crenate—Scalloped, with rounded teeth.
Cupreous—Coppery in color.

Dentated—Furnished with teeth.
Depressed—Flattened down.
Dilated—Widened, expanded.
Dimidiate—Half round.
Discal—Relating to the disk; discoidal.

Edentulous—Destitute of teeth.
Emarginate—Notched; terminating in an acute notch at tip.
Entire—(Wings) with a simple, not indented, edge.
Epistoma—That part of the face between the front and labrum.
Eruca—The larva.
Excurved—Curved outwards.
Exserted—Protruded; opposed to inclosed.
Exuvia—Cast-off skin.

Facies—Appearance, aspect.
Falcate—Sickle-shaped.
Fascia—A stripe broader than a line.
Fauna—An assemblage of animals peopling a region or country.
Fenestrated—Marked with transparent spots surrounded by a darker color, like window panes.
Ferruginous—Rust-colored.
Filiform—Thread-like.
Flavescent—Somewhat yellow.
Flexuous—Almost zigzag.
Foliaceous—Leaf-like.
Forcipated—Forceps-like.

FOVEA—A more or less rounded depression.
FREE—Unrestrained in articulated movement; not soldered at the points of contact.
FRONT—The fore-face, bounded by the eyes, the vertex, and often beneath by the epistoma, or clypeus.
FULIGINOUS—Of the color of dark smoke.
FULVO-ÆNEOUS—Brazen, with a tinge of brownish yellow.
FULVOUS—Tawny; color of the common deer.
FURCATED—Forked.
FUSCO-TESTACEOUS—Dull reddish brown.
FUSCOUS—Dark brown; approaching black.
FUSIFORM—Spindle-shaped; gradually tapering at each end.

GANGLION—A center of the nervous system, containing nerve cells, and receiving and giving out impressions.
GEMINATE—Arranged in pairs; twin.
GEMMIPAROUS—A sexual generation by new individuals arising as buds from the body of the parent.
GLABROUS—Smooth; opposed to hairy, downy, villous.
GLAUCOUS—Gray; bluish green.

HAMULE—A little hook.
HASTATE—Halbred shaped.
HAUSTELLATE—Furnished with a proboscis or tongue-like mouth.
HEXAPODOUS—Provided with six feet.
HIRSUTE—Clothed with shaggy hairs.
HYALINE—Transparent; of the color of water.
HYPOSTOMA—The clypeus in diptera.

INCRASSATED—Thickened; swelled out on some particular part.
INFUMATED—Clouded.
INFUSCATED—Darkened with a blackish tinge.
INTERRUPTED—Suddenly stopped.
INVOLUTED—Rolled inwards spirally.
IRRORATED—Freckled; sprinkled with atoms.

LAMINA—A plate or sheet-like piece.
LEMELLIFORM—Sheet or leaf-like.
LIMBATE—When a disk is surrounded by a margin of a different color.
LINEAR—Like a line.
LINEATED—Provided with line-like marks.

MANDIBULATE—Furnished with mandibles; opposed to haustellate.
MARGINATED—Surrounded by an elevated or attenuated margin.
MEMBRANACEOUS—Thin, skinny, and semi-transparent like parchment.
MUCRONATE—Ending in a sharp point.
MUTIC—Unarmed.

NYMPH—Old name for pupa.

OBCORDATE—Inversely heart shaped.
OBOVATE—Inversely ovate; the smaller end turned towards the base.
OBSOLETE—Not distinct; or almost lost to view.
OBTECTED—Covered.
OCHREOUS—Of a more or less deep ochre color.
OLIVACEOUS—Olive colored.
OPERCULUM—A lid; a small valvular appendage.
OVAL—Egg shaped.
OVATE—More or less oval.
OVIPOSITION—The act of depositing eggs.

PETIOLATED—Supported on a stem.
PICEOUS—Pitchy, color of pitch; shining reddish black.
PILOSE—Clothed with pile, or dense down.
PROCESS—A projection.
PRODUCED—Drawn out; prolonged.
PRUINOSE—Frosty.
PSEUDOVA—Unimpregnated eggs, which produce young, as in those laid by virgin Aphides.
PUBESCENT—Coated with very fine hairs, or down.
PULVERULENT—Dusty.
PUNCTURED—Marked with numerous small impressed dots.

RAPTORIAL—Adapted for seizing prey.
RECURVED—Curved backwards.
RENIFORM—Kidney-shaped.
RETICULATED—Marked like net work.

REVOLUTE—Rolled backwards.
ROSTRUM—The beak or sucking mouth-parts in Hemiptera.
RUFESCENT—Somewhat reddish.
RUFOUS—Reddish.
RUGOSE—Wrinkled.

SANGUINEOUS—Blood-red.
SCABROUS—Rough like a file; with small raised dots.
SCALLOPED—Edge marked by rounded hollows, without intervening angles.
SERICEOUS—Having the surface with a silk-like gloss, usually from the presence of minute, dense hairs.
SERRATED—Like saw-teeth.
SETACEOUS—Bristle-like.
SESSILE—Not stalked.
SINUATED—Scooped out.
SPINOUS—Armed with spines.
SPURS—Stiff bristles, or spines, on the tibiæ.
STRIA—A line usually depressed; sometimes composed of punctures.
SUBADUNCATE—Somewhat hooked or curved.
SUBULATE—Shaped like an awl.
SULCATE—With groove-like excavations.
SUTURE—A seam, or impressed line, usually between segments.

TAWNY—Fulvous; a pale, dirty yellow.
TENERAL—A state of the imago (Neuroptera) after exclusion from the pupa, in which it has not fully completed its coloring, clothing, etc.
TESSELLATE—Spotted like a checkerboard.
TESTACEOUS—Dull red, brick color.
TOMENTOSE—Covered with fine matted hair.
TRUNCATED—Cut squarely off.
TUBERCULOSE—Covered with tubercle-like prominences.

UNCINATE—Hooked at the end.
UNEQUAL—Differing in size or length.
UNGUICULATE—Armed with a hook or nail.

VALVULE—A small valve-like process.
VENTRAL—Relating to the under surface of the abdomen.
VERTICILLATE—Placed in whirls.
VERRICULATE—With thick set tufts of parallel hairs.
VERRUCOSE—Covered with wart-like prominences.
VILLOSE—Clothed with soft, rather long hair.
VULVA—Orifice of the oviduct.

BOTANY.

ABORTION—The suppression or imperfect development of any part.
ABORTIVE—Imperfectly developed.
ABRUPT, ABRUPTLY—Indicating a sudden transition or termination; *abruptly pinnate*, pinnate without a terminal leaflet.
ACAULESCENT—Stemless or apparently so.
ACCUMBENT COTYLEDONS—Having an edge against or towards the radicle.
ACEROSE—Needle-shaped, as a pine leaf.
ACHLAMYDEOUS—Without perianth.
ACICULAR—Needle or bristle-shaped; more slender than *acerose*.
ACINACIFORM—Scimeter-shaped.
ACOTYLEDON—A plant whose embryo is without cotyledons, as *Cuscuta;* applied also to cryptogams as plants without seed or embryo.
ACROGENOUS—Growing by terminal buds.
ACULEATE—Having sharp points or prickles.
ACUMINATE—Tapering to a point.
ACUTE—Sharp at the end, or at the edge of margin.
ADNATE—United; used properly of the surfaces of different organs, as of calyx and ovary.
ADVENTIVE—Accidentally present.
ÆSTIVATION—The arrangement of leaves or of the parts of the perianth in the bud.
AGGREGATED—Crowded together, but not coherent.
AKENE; ACHENIUM—A dry, hard, indehiscent, one-celled, one-seeded and seed-like fruit.
ALA, pl. ALÆ—A wing, or sometimes an axil; in mosses, applied to the basal lobes or auricles of the leaves.
ALAR—In the axils or forks; also belonging to the wings or auricles.

Albumen—The nutritive material of the seed, within its coats and exterior to the embryo.
Albuminous—Provided with albumen.
Allaceous—Applied to the peculiar smell and taste of garlic and onions.
Alpine—Peculiar to high altitudes, above the line of tree-growth.
Alternate—Following one another at intervals, as leaves upon a stem; following by turns; not opposite; intermediate.
Alveolate—Honey-combed; deeply and closely pitted.
Ament—A unisevual spike with scaly bracts, as in the willow.
Amorphous—Without definite form; of abnormal form.
Amphigastria—In hepaticæ, small stipule-like accessory leaves on the under side of the stem.
Amphitropous—Applied to an inverted ovule or seed with the hilum lateral.
Amplexicaul—Of leaves, clasping the stem.
Anatropous—Of an inverted ovule or seed, with the rhaphe extending its whole length.
Ancipital—Two-edged.
Androgynous—Having both male and female flowers.
Angiospermous—Bearing seeds in a closed pericarp.
Annual—Of only one year's duration.
Annular—Having the form of a ring.
Annulus—In mosses, the ring of cells between the operculum and the orifice of the capsule.
Anterior—Equivalent to inferior or lower, in the sense of away from the axis and toward the bract.
Anther—That part of the stamen which contains the pollen.
Antheridium—In cryptogams, the male organ of inflorescence, corresponding to the anther.
Antheriferous—Bearing anthers.
Antherizoids—In cryptogams, the minute, usually ciliated organs developed by the antheridia, corresponding to pollen-grains.
Apetalous—Having no corolla or inner perianth.
Apex—The tip or summit of a thing.
Aphyllous—Not bearing leaves.
Apical—At the apex.
Apiculate—Abruptly terminated by a short point or tip.
Apophysis—In mosses, an enlargement of the pedicel at the base of the capsule.
Appendage—Something added or attached to an organ, but essential to it.
Appressed—Pressed close.
Apterous—Not winged.
Aquatic—Growing in water.
Arachnoid—Resembling cobweb.
Arborescent—Becoming a tree or tree-like.
Archegonium—In mosses, the rudimentary organ which develops into the fruit.
Arcuate—Arched; bent like a bow.
Areola, pl. **Areolæ**—The spaces in any reticulated surface.
Areolate—Divided into small spaces or areolæ.
Areolation—Any system of cellular or reticulated markings.
Aril—An expanded appendage of the hilum enveloping the seed.
Arillate—Having an aril.
Arilliform—Resembling an aril.
Aristate—Having an awn.
Aristulate—Having a very small awn.
Articulated—Jointed.
Axil—The angle formed by a leaf or branch with the stem.
Axile, or **Axial**—Situated in the axis or relating to it.
Axillary—Situated in an axil.
Axis—The central line of a body in the direction of its length; the stem.
Awn—A bristle-like terminal or dorsal appendage.

Baccate—Berry-like; pulpy.
Banner—A name often applied to the standard or upper petal of a papilionaceous flower.
Barbed—Furnished with barbs.
Bark—The outer covering or rind of a stem.
Basal—At, from, or relating to the base.
Base—The end next the point of attachment or support; the lower end.
Basifixed—Attached by the lower end.
Beak—A prolonged tip.
Beaked—Ending in a beak.
Berry—A simple fruit of which the whole substance, excepting the seeds, is pulpy.
Bifarious—In two ranks.
Bifid—Two-cleft.
Bilocular—Two-celled.
Bipinnate—Twice pinnate.
Biserrate—Doubly serrate.
Bisexual—Having both stamens and pistil, or corresponding organs (in cryptogams).

Bladdery—Thin and inflated.
Blade—The expanded portion of a leaf.
Bract—A leaf, or modification of a leaf, subtending a flower or flower-cluster.
Bracteolate—Having bractlets.
Bracteate—Having bracts.
Bractlet—A secondary bract upon the pedicel of a flower.
Branch—A division of the stem.
Branchlet—A secondary or ultimate division of a stem.
Bristle—A stiff hair or bristle-like appendage.
Bud—The early rudimentary form of a stem or branch, or an unexpanded flower.
Bud-scales—The scales which form the outer coats of a leaf-bud.
Bulb—A subterranean roundish body, formed of fleshy scales or coatings, essentially a rudimentary stem or leaf-bud, and at length developing a flower stem and often leaves.
Bulbiferous—Bulb-bearing.
Bulblet—A small bulb formed in the axil of a leaf or bract.
Bulbous—Producing bulbs; bulb-like.

Caducous—Falling very early; not at all persistent.
Calcarate—Spurred.
Callus—A callosity or hard protuberance.
Calyx—The outer envelope of a flower.
Campanulate—Bell-shaped or cup-shaped, with broad base.
Canaliculate—Channeled; having a longitudinal groove.
Canescent—Hoary with a grayish pubescence or puberulence.
Capillary—Very slender and hair like.
Capitate—Subglobose and terminal, like a head: collected in a head.
Capitellate—Diminutive of *capitata.*
Capsular—Relating to or like a capsule.
Capsule—A dry dehiscent fruit formed from a compound pistil—the fruit of mosses.
Carina—A keel, a prominent longitudinal ridge along the middle of a convex dorsal surface; applied also to the coherent lower petals of a papilionaceous flower.
Carinate—Keeled.
Caryopsis—A seed-like fruit with the very thin pericarp adherent throughout to the real seed, as in most grasses.
Carpel—A simple pistil, or one of the several parts of a compound pistil.
Carpophore—A prolongation of the axis between the carpels, as often in the umbelliferae.
Cartilaginous—Firm and tough like cartilage.
Caruncle—An outgrowth or expended appendage at the base of a seed; sometimes applied to an enlargement of the rhaphe.
Catkin—A scaly unisexual spike; an ament.
Caudate—Having a tale or slender-like tail appendage.
Caudex—The trunk of a palm or other arborescent endogen; or the persistent base of any herbaceous perennial.
Caudicle—In orchids, the slender foot stalk of the pollenmasses.
Caulescent—Having a manifest stem.
Cauline—Belonging to the stem.
Cell—A cavity or separate inclosure, as of an ovary or anther; a minute sac or hollow structure; the unit of all cellular tissue.
Cellular—Composed of such minute cells.
Centrifugal—Developing from the center outward, as in the cyme.
Centripetal—Developing from the margin toward the center, or from below upward; as in the corymb, raceme, etc.
Cernuous—Nodding, usually indicating less inclination than pendulous.
Cespitose—Growing in tufts or turf-like; forming mats.
Channeled—Having a deep longitudinal groove, like a gutter.
Claw—The elongated narrow base of a petal.
Cleft—Cut somewhat deeply, usually about half way to the center or midrib.
Climbing—Rising by the aid of some support.
Clustered—Collected near together.
Cohesion—The sticking together of parts, or their more intimate coalescence or adnation.
Collateral—Side by side.
Columella—The persistent axis of a capsule.
Coma—A tuft of hairs, especially upon a seed.
Common—Belonging equally to more than one.
Complicate—Folded together.
Compound—The opposite of *simple;* consisting of more than one; divided.
Conduplicate—Doubled together lengthwise, of leaves.
Cone or Strobile—A dry multiple fruit formed of densely imbricated scales.
Confervoid—Of slender diffuse filamentose structure, like *Conferva* among the Algæ.
Confluent—Blended or running together.
Connivent—Coming in contact; converging together.
Constricted—Contracted or drawn together, as a bag by its string.
Continuous—Not interrupted by joints or otherwise.
Contorted—Twisted; in aestivation, an equal and uniform somewhat oblique overlapping and rolling up of the parts of the circle.

Contracted—Reduced in width or length.
Corky—Resembling cork.
Corneous—Of the consistence of horn; horny.
Corolla—The inner perianth, within the calyx, consisting of the petals.
Corona, or Crown—An appendage at the throat of the corolla, or a crown-like margin at the top of a seed or other organ.
Coronate—Having a crown.
Corymb—A flat-topped, or convex, open inflorescence, with short axis, flowering from the margin inward; a depressed raceme.
Creeping—Running upon or under the ground and rooting.
Crenate—Scalloped; having rounded teeth, with shallow, acute sinuses.
Cristate—Crested.
Crustaceous—Hard and brittle.
Cryptogamous—Flowerless, fructifying without the agency of proper stamens and pistils.
Cucullate—Shaped like a hood or cowl, concave, and somewhat arched, or like an ovate leaf with edges inrolled; in mosses, applied to a conical calyptra cleft at one side.
Culm—The hollow jointed stem peculiar to grasses.
Cultrate, or Cultriform—Shaped like a coulter or broad knife blade.
Cuneate, or Cuneiform—Wedge-shaped; triangular, with the angle downward.
Cut—Cleft or incised.
Cuticle—The outer skin or epidermis; the thin outer layer of the bark.
Cylindraceous—Somewhat, or nearly cylindrical.
Cylindrical—In the form of a cylinder.
Cyme—A broad and flattish inflorescence, flowering from the center outward.

Deciduous—Falling off after a time; not persistent.
Declinate, or Declined—Bent or curved downward.
Decompound—Repeatedly compound, or divided.
Decumbent—Reclining at base, the summit ascending.
Decurrent—Running down the stem; applied to a leaf prolonged below its insertion.
Decussate—In pairs alternating at right angles, or similarly in threes.
Definite—Of a constant number, not exceeding twenty; limited or determinate, as *definite inflorescence*, in which a flower terminates the axis.
Deflexed—Bent or turned down abruptly.
Dehiscence—The regular opening of a capsule or anther-cell at maturity; the longitudinal splitting of the teeth in mosses, etc.
Dehiscent—Opening regularly by valves, slits, etc.
Depauperate—Impoverished; reduced in size by unfavorable surroundings.
Depressed—Somewhat flattened from above.
Diadelphous—In two sets or clusters.
Diandrous—Having two stamens.
Dicarpellary—Consisting of two carpels.
Dichotomous—Forking regularly by pairs.
Diclinous—Of separate sexes; unisexual.
Dicotyledonous—Having an embryo with two cotyledons.
Didymous—In pairs; twin.
Didynamous—Having four stamens disposed in two unequal pairs.
Diffuse—Widely spreading, widely and loosely branched.
Digitate—Fingered; applied to a compound leaf having the leaflets all diverging from the top of the petiole.
Dimerous—Having all the parts in twos, as the sepals, petals, stamens, etc., of a flower.
Dimidiate—Halved, as though one half were wanting.
Dimorphous—Occurring in two forms.
Diœcious—Unisexual, the flowers of different sexes borne by separate plants.
Diœcio-Polygamous—Diœcious with some perfect flowers intermixed.
Diphyllous—Two-leaved.
Dipterous—Two-winged.
Disciform—In the shape of a disk; depressed and circular.
Discoid—In compound flowers, having disk flowers only, without rays.
Disk—A dilation or development of the receptacle around the base of the pistil. In compound flowers, the inner series of tubular flowers as distinct from the marginal ray.
Dissected—Deeply cut, or divided into numerous segments.
Dissepiment—A septum or partition separating the cells of an ovary or fruit.
Distichous—Arranged in two vertical rows; two-ranked.
Distinct—Separate; not united.
Divaricate—Widely divergent, nearly at right angles.
Divergent—Receding from each other.
Divided—Cleft to the base or to the mid-nerve.
Dorsal—Upon or relating to the *dorsum*, or back.
Drupaceous—Resembling or of the nature of a drupe.
Drupe—A stone fruit; a fleshy or pulpy fruit, with the seed or kernel inclosed in a hard or stony casing (*putamen*).
Drupelet—A diminutive drupe, as each of the several parts of a blackberry.
Dwarf—Much below the ordinary size of its kind.

Elater—In Hepaticæ, a slender elongated cell occurring among the spores, usually containing one or more spiral threads.
Ellipsoidal—Nearly elliptical; or of solids, elliptical in outline.
Elliptical—In the form of an ellipse, oblong, with both ends uniformly and somewhat gradually rounded.
Emarginate—Notched at the extremity.
Embracing—Clasping at base.
Embryo—The rudimentary plantlet formed within the seed.
Emergent, Emersed—Raised above the water; of the capsule in mosses when barely exserted from its involucral leaves.
Endocarp—The inner layer of the pericarp, lying next to the seed.
Endogenous—Growing from within instead of by superficial increments, the growth ordinarily being general throughout the substance of the stem.
Endogens—Plants with an endogenous structure.
Ensiform—Sword-shaped, as the leaf of an iris.
Entire—With the margin uninterrupted, without teeth or division of any sort.
Ephemeral—Lasting but a day, or for a very short time.
Epidermis—The thin membrane forming the outer surface of leaves and young stems.
Epigynous—At or upon the top of the ovary.
Equal—Alike in size or number, etc.; more frequently used in respect to length.
Equitant—Astride, of conduplicate leaves which fold over each other in two ranks, as in iris.
Erect—Upright; perpendicular to the surface of attachment.
Evergreen—Bearing its foliage through all the seasons.
Exalbuminous—Destitute of albumen.
Exceed—To surpass in length.
Excentric—Out of the center; one-sided.
Excurrent—Running out, as a nerve projecting beyond the apex or margin of the leaf.
Exocarp—The outer portion of the pericarp.
Exogeneous—Growing by successive external layers, as in dicotyledonous plants.
Exogens—Plants having an exogenous structure.
Explanate—Opened out flat.
Exsert, Exserted—Projecting beyond an envelope, as stamens standing out of the corolla.
Exstipulate—Without stipules.
Exterior—Outer.
Extra-axillary—Growing from outside of the axil.
Extrorse—Directed outward.

Farinaceous—Mealy; containing or yielding flour or starch.
Fertile—Capable of producing fruit, as a pistillate flower; applied also to a pollen-bearing stamen.
Fibrous—Composed of threads and fibres.
Filament—That part of the stamen which supports the anther; any thread-like body.
Filamentous—Composed of threads or filaments.
Filiform—Thread-shaped; long, slender, and terete.
Fimbriate—Fringed with narrow processes; having the margin finely dissected.
Fistular—Hollow and cylindrical.
Fleshy—Succulent, juicy.
Flexuous or Flexuose—Bent or curving alternately in opposite directions.
Floral—Belonging to the flower.
Floret—A small flower; one of a head.
Foliaceous—Leaf-like in structure and appearance; leafy.
Foliate—Having leaves, as in bifoliate, etc.
Foliolate—Having leaflets.
Follicle—A pod, formed from a simple pistil, dehiscing along the ventral suture only.
Foot-stalk—A petiole, pedicel, or other slender support.
Foreamen—The narrow orifice at the apex of an ovule.
Forked—Branching equally, or divergently.
Foveate—Pitted; marked with deep depressions.
Foveolate—Diminutive of the last; marked by minute pits.
Free—Not adnate or coherent to other organs.
Fructification—The bearing of fruit, or the organs concerned in the production of fruit.
Fruit—The matured seed—or spore vessel, of whatever kind, with its appendages and contents.
Frutescent—Shrubby or somewhat so.
Fruticose—Decidedly shrubby.
Fugacious—Soon falling; of short continuance.
Funiculus—The stalk of an ovule or seed.
Funnel-form—Tubular, but expanding gradually from the narrow base to the spreading border or limb.

Generic—Relating to the genus.
Geniculate—Bent abruptly at an angle, like the knee.
Genus, pl. Genera—The divisions of an Order or Family, each consisting of a more or less clearly defined group of nearly related species.

Germination—The sprouting of a seed; the development of the young plant from the embryo.

Gland—Any secreting structure, depression, or prominence, on any part of a plant, or any structure having a similar appearance.

Glandular—Bearing glands, or gland-like.

Globose, Globular—Round; spherical, or nearly so.

Glutinous—Viscid; sticky; covered with a sticky secretion.

Gymnosperms—Plants having naked seeds, or in which the typical naked ovule is fertilized directly by the pollen without the intervention of a stigma.

Gynoecium—A term applied to the pistil or aggregate pistils of a flower.

Habit—The general form and appearance of the plant.

Habitat—The locality or geographical range of a plant.

Hairs—Slender, cellular outgrowths from the epidermis of plants, of various forms and kinds.

Hairy—Covered with hairs more or less loosely.

Head—A cluster of flowers, which are sessile or nearly so, upon a very short axis or receptacle; a shortened spike.

Herb—A plant that has no persistent woody growth above the base.

Herbaceous—Having the character of an herb; not woody or shrubby.

Heterogamous—Bearing two kinds of flowers.

Hoary—Grayish-white, with a fine close pubescence.

Homogamous—Having only one kind of flowers.

Homogenous—Uniform in character, nature, or kind.

Hybrid—A cross between two species, produced by the fertilization of the flower of one species by the pollen of another.

Immarginate—Not margined or bordered.

Immersed—Growing wholly under water; in mosses, used of a capsule inclosed within its involucral leaves.

Incised—Irregularly, sharply, and deeply cut.

Included—Inclosed by the surrounding organs; not exserted.

Incomplete—Not perfect; wanting some of its parts.

Incumbent—Resting upon; of cotyledons, lying with one side toward the radicle; of anthers, lying against the face or inner side of the filament.

Incurved—Curved inward.

Indefinite—Of number, variable or very numerous; indeterminate.

Indehiscent—Not opening regularly by valves or otherwise.

Indeterminate—Of inflorescence, not definitely terminated, but continuous with the axis, the lower or marginal flowers being the first to open.

Indigenous—Native to the country.

Induplicate—With margins folded inward.

Indusium—In ferns, the shield or scale-like covering of the fruit-cluster.

Inferior—Lower; that part of a flower, etc., which is toward the bract; applied also to a calyx that is free from the ovary, and to an ovary that is adnate to the calyx.

Inflexed—Bent or turned abruptly inward.

Inflorescence—The flowering portion of a plant, and especially the mode of its arrangement.

Insertion—The place or mode of attachment of an organ.

Irregular—Not regular; unsymmetrical: with its parts unequal or unlike.

Lacerate—Torn; irregularly and deeply cleft.

Lactescent—Yielding milky juice.

Lacunose—Having numerous pits, depressions, or cavities.

Lanceolate—Shaped like a lancehead; tapering upward from a narrowly ovate or subovate base.

Lanuginous—Provided with wool; woolly.

Lateral—At the side; attached to the side.

Leaf—The principal organ of vegetation borne by the stem, in which the sap is elaborated for the growth of the plant.

Leaf-blade—The dilated portion of a leaf.

Leaf-bud—A bud which is the rudiment of a branch, and tends to develop into one.

Leaflet—A separate division of a compound leaf.

Leafstalk—The footstalk or petiole of a leaf.

Leathery—Resembling leather; coriaceous.

Legume—A normally one-celled capsule, formed from a single carpel, but dehiscing by two valves, as in the pea.

Liber—The inner and often fibrous layer of bark.

Ligneous—Woody.

Limb—The dilated and usually spreading portion of a perianth or petal, as distinct from the tubular part or claw: the blade of a leaf.

Linear—Narrow and elongated, with parallel margins.

Lineate—Marked with lines.

Lineolate—Marked with fine lines.

Linguiform, Lingulate—Tongue-shaped; ligulate.

Lobe—Any division of a leaf, corolla, etc., especially if rounded.

Macro.—A Greek prefix signifying large or long.

Macrospore.—In some cryptogams, the larger of the two kinds of spores.

Maculate.—Marked with spots or blotches.

Male.—Staminate.

Mealy.—Covered with a whitish, mealy powder.

Midrib, or Midnerve.—The central and principal nerve of a leaf.

Moniliform.—Resembling a necklace or string of beads; contracted or interrupted at regular intervals.

Monocarpellary—Formed of a single carpel.

Monocarpic—Bearing fruit but once.

Monocotyledon—A plant whose embryo has a single cotyledon.

Monophyllous—One-leaved; composed of a single leaf.

Monosepalous—Gamosepalous, having the calyx more or less in one piece.

Monospermous—One-seeded.

Naked—Bare; without its usual appendages or covering, as a stem without leaves.

Nectar—A sweet secretion within a blossom.

Nerve—A simple vein; a rib.

Nerved—Having nerves.

Nodding—Hanging down; somewhat inclined from the perpendicular.

Normal—According to rule or standard; not varying from the type.

Numerous—Indefinite in number.

Nut—A hard, indehiscent one-seeded fruit, usually resulting from a compound ovary.

Oblanceolate—Inverted lanceolate; with the broadest part toward the apex.

Oblique—Turned to one side; unequally sided.

Oblong—Considerably longer than broad, and with nearly parallel sides.

Obovate—Inverted ovate, the broader part toward the apex.

Obovoid—Inverted egg-shaped, the broader part above.

Obtuse—Blunt or rounded at the end.

Obversely—In a reverse manner.

Orbicular—Circular, or nearly so.

Order—A principal group next above the genus in rank, and including related genera more or less distinguished from others by certain common characters.

Organ—Any part of a plant concerned in its growth and welfare, having a special object to serve and more or less essential.

Orthotropous—Applied to an ovule or seed that is straight and attached immediately by its base.

Oval—Broadly elliptical.

Ovate—Shaped like the longitudinal outline of an egg, the broader portion toward the base; also egg-shaped and applied to solids.

Ovoid—Egg-shaped.

Ovule—A rudimentary organ which after impregnation becomes a seed.

Ovuliferous—Bearing ovules.

Palate—A protrusion of the lip of a bilabiate corolla.

Palea—A chaff or chaffy bract; in grasses, the two inner bracts of the flower.

Paleaceous—Chaffy or furnished with chaff.

Palet—The same as *palea*, used especially of grasses.

Palmate—Of leaves, compound with the leaflets radiating from the summit of the petiole.

Palmately—In a palmate manner.

Panicle—A loose, irregularly branched inflorescence.

Panicled, Paniculate—After the manner of a panicle; bearing a panicle.

Parasitic—Growing upon and deriving nourishment from another plant.

Parenchyma—The soft, cellular tissue of plants, as the green, fleshy part of a leaf.

Parenchymatous—Like or formed of parenchyma; also applied to cells narrower at the ends and overlapping each other.

Parietal—Relating to or situate upon the walls of a cavity.

Parted—Cleft nearly to the base.

Partial—Secondary, as distinguished from the principal and primary.

Pedicel—The footstalk or support of a flower.

Pedicellate—Borne on a pedicel.

Peduncle—A general or primary flower-stalk.

Pedunculate—Furnished with a peduncle.

Peltate—Shield-shaped; flat, and attached to its support by its lower surface.

Pendent—Hanging on its stalk or support.

Pendulous—Hanging nearly inverted from its support; of ovules, more or less drooping, as distinct from suspended.

Penicillate—Resembling a brush of fine hairs.

Pericarp—The seed-vessel or ripened ovary.

Persistent—Not falling off; of leaves continuing through the winter.

Personate—Used of a labiate corolla with prominent palates closing the throat.

Petal—One of the parts of a polypetalous or nearly divided corolla.

Petaloid—Colored, and resembling a petal.

Petiolar—Borne upon or relating to a petiole.

Petiole—The footstalk of a leaf.

Petioled, Petiolate—Having a petiole.
Petiolule—The footstalk of a leaflet.
Phænogam—A *phænogamous* plant fructifying by means of stamens and pistils.
Phyllode—A leaf reduced to a simple petiole, which may be more or less dilated vertically.
Piliferous—Bearing or tipped with hairs.
Pilose—Hairy, usually with soft distinct hairs.
Pinna—One of the principal divisions of a compoundly pinnate leaf.
Pinnate—Having its parts arranged in pairs along a common rhachis.
Pistil—The female organ of a phænogam, consisting of the ovary with its styles and stigmas.
Pistillate—Having a pistil and no stamens, as distinct from perfect or staminate.
Pith—The soft and spongy central cellular part of a stem.
Pitted—Marked with small depressions or pits.
Placenta—That part of the ovary or fruit which bears the ovules and seeds.
Plane—Having a flat surface.
Plumule—The bud or growing point of the embryo between the cotyledons.
Pollen—The powdery or sometimes waxy contents of the anther.
Polygamous—Having both perfect and unisexual flowers upon the same plant.
Polymorphous—Of many forms; variable in form.
Polypetalous—Having distinct petals.
Pome—A fleshy fruit, like the apple, inclosing several parchment-like or bony carpels.
Praemorse—Terminating abruptly, as if bitten off.
Prickle—A small spine, an outgrowth of the bark or cuticle.
Pungent—Terminating in a rigid and stout sharp point or prickle.

Raceme—A form of inflorescence with pedicellate flowers upon a simple prolonged axis, the flowers developing from below upward.
Racemose—In racemes, or resembling a raceme.
Radial—Belonging to the ray of a compound flower.
Radical—Belonging to or preceding from the root, or from the base of the stem.
Radicle—That part of the embryo below the cotyledons, its stem portion and the primal internode, developing the root from its lower extremity.
Rameal—Belonging to a branch.
Ramose—Branching.
Ramulose—Bearing branchlets.
Reflexed—Bent abruptly down or backward.
Refracted—Reflexed from the base.
Regular—Symmetrical in form; uniform in shape or structure.
Rib—A principal and prominent nerve of a leaf.
Ribbed—Furnished with prominent nerves.
Ringent—Gaping, applied to a labiate corolla with open throat.
Root—That part of a plant growing underground and supplying it with nourishment.
Rootlet—A very slender root or branch of a root.
Rostellate—Diminutive of rostrate; having a small beak.
Rostrate—Beaked; bearing a slender terminal process.
Rosulate—Collected in a rosette.
Rotate—Wheel-shaped; of a corolla, spreading abruptly from near the base and nearly flat.
Rotund—Rounded in outline.
Rough—Not smooth to the touch; scabrous.
Rudiment—A partially developed and imperfect organ.
Rudimentary—In an imperfectly developed condition.
Rufous—Reddish or brownish-red.
Rugose—Wrinkled; ridged.
Ruminated—Penetrated by irregular channels, as a nutmeg.
Runcinate—Deeply toothed or incisely lobed, with the segments directed backward.
Runner—A very slender prostrate branch (stolon), rooting and developing a new plant at the nodes or tip, as in the strawberry.

Sarcocarp—The succulent part of a fleshy fruit.
Sarmentose—Producing long runners.
Scabrous—Rough to the touch, with minute rigid points.
Scales—Usually variously modified bracts or leaves, thin and scarious, or coriaceous, fleshy, foliaceous, or woody; often imbricated.
Scandent—Climbing.
Scape—A naked peduncle rising from the ground.
Scapigerous—Producing scapes.
Scar—A mark of separation left upon a surface, as upon a stem by the fall of a leaf.
Scarious—Thin, dry, and membranaceous, not green.
Scobiform—Having the appearance of sawdust.
Seed—The ripened ovule, consisting of the embryo with its proper envelopes.
Segment—One of the parts of a leaf or other organ that is cut or divided; more general than *Lobe*.
Sepal—A leaf or division of a calyx.

Septiferous—Bearing the partitions after dehiscence.
Serrate—Having the teeth directed forward, like the teeth of a saw.
Shrub—A plant woody throughout, of less size than a tree.
Shrubby—Having the character of a shrub.
Spadix—A spike with usually a thickened fleshy rhachis and subtended by a spathe.
Span—The distance between the extremities of the thumb and little finger when extended; about nine inches.
Sparse—Thinly scattered.
Spathaceous—Bearing or resembling a spathe.
Spathe—One or more clasping and often sheathing bracts inclosing a flower-cluster or inflorescence, and mostly colored.
Spatulate—Narrowly attenuate downward from an abruptly rounded summit.
Species—A group of things of the same kind having essentially the same characters.
Specific—That which relates to or defines a species.
Spicate—In spikes or resembling a spike.
Spine—A sharp woody or rigid outgrowth from the stem, a modification of a branch, leaf, or stipule.
Spinulose—Having diminutive spines.
Spores—In cryptogams, the minute bodies which are the result of fructification and which correspond to some extent to the seeds of phænogams, though without embryo, and reproducing the plant only indirectly.
Spur—A usually slender tubular process from some part of a flower, often nectariferous.
Squamose—Furnished with scales.
Squarrose—Roughened and jagged, with projections spreading every way, as by the divaricately spreading ends of crowded leaves or bracts.
Stamen—The pollen-bearing organ of the flower, consisting of an anther usually supported upon a stalk or filament.
Stamineal—Relating to or consisting of the stamens.
Stemless—Without manifest stem above ground.
Sterile—Barren; not capable of producing seed; a sterile stamen is one not producing pollen.
Stigma—That portion of the pistil without epidermis through which the pollen-tubes effect entrance to the ovules, very variable in shape and position.
Stigmatic—Belonging or relating to the stigma.
Stipule—An appendage to the base of a petiole, very various in form and character.
Stock—A caudex or rhizome; the persistent base of an herbaceous perennial.
Stone—The hard endocarp or *putamen* of a drupe.
Style—That portion of the pistil between the ovary proper and the stigma, usually attenuated, often wanting.
Succulent—Fleshy and juicy.
Sucker—A shoot from the underground base of a stem, or from underground roots or rhizomes.
Suffruticose—Low and shrubby.
Superior—Growing above; a superior ovary is one wholly above and free from the calyx; in a lateral flower, nearest to the axis.
Surculose—Producing suckers.
Suture—A line of union, or of dehiscence.
Symmetrical—Regular in shape or in the number of its parts.
Syncarpous—Composed of two or more united carpels.
Synonym—A superseded or unused name.

Tendril—A thread-like production from an axil, the extremity of a leaf, or elsewhere, capable of coiling and used for climbing.
Thyrse—A contracted or close ovate panicle.
Tissue—The various forms of cellular and vascular structure of which a plant is composed.
Tomentose—Pubescent with matted wool.
Tomentum—Dense matted woolly pubescence.
Trifid—Three-cleft.
Trifoliate—Three-leaved.
Trifoliolate—Having three leaflets.
Truncate—Ending abruptly, as if cut off transversely.
Tuber—A thickened rhizome, with scattered buds or eyes.
Tubercle—A small projection or pimple; a small tuber or a tuberous root.
Tuberculate—Covered with small rounded prominences or knobs.
Tuberiferous—Bearing tubers.
Tuberous—Resembling a tuber.
Tubular—Tube-shaped.
Tubuliflorous—When the flowers of a head have only tubular corollas.
Turbinate—Top-shaped.
Twining—Ascending by winding about a support.
Type—The ideal pattern or form.
Typical—That which corresponds to or represents the type. A typical species is one upon which the generic character was founded, or one which conforms most closely to the general characters of the genus, deviations from which form the basis for subgenera, etc. So the typical form of a species is that upon which the specific character is based, as distinguished from all varieties, sports, etc.

Umbel—An umbrella-shaped inflorescence, the pedicles radiating from the summit of the common peduncle.

Umbellate—Bearing or growing in umbels.

Umbellet—A small secondary umbel upon the ray of the primary.

Umbilicate—Pitted in the center; navel-like.

Umbonate—Bossed; bearing a stout projection in the center like the boss of a shield.

Umbraculiform—Having the form of an umbrella.

Unarmed—Without prickles, spines, or the like.

Uncinate—Hooked at the extremity.

Undulate—Wavy, alternately raised above and depressed below the general plane.

Undershrub—A very low shrub.

Unequal—Not equal; unsymmetrical; *unequally pinnate*, with an odd terminal leaflet.

Unilocular—One-celled.

Uniovulate—Having a single ovule.

Uniserial—In one horizontal row or series.

Unisexual—Of one sex; of flowers, having stamens only or pistils only.

Veined—Furnished with veins.

Veinless—Destitute of evident veins.

Veins—Bundles of woody tissue traversing a leaf or other flat surface, and forming its framework, especially those which branch (as distinct from *nerves*).

Veinlet—A small subdivision of a vein.

Velutinous—Velvety; covered with a dense, soft fine, pubescence.

Ventral—Belonging to the anterior or inner face of a carpel, etc.; the opposite of *dorsal*.

Vernal—Appearing in spring.

Verrucose—Covered with wart-like elevations.

Versatile—Swinging; turning freely on its support.

Vertex—The apex of an organ.

Vessels—Elongated tubular cells, of various kinds, forming the vascular tissue of plants.

Virgate—Like a wand or rod, slender, straight, and erect.

Viviparous—Propagating by bulbs or bulblets instead of by seeds, or with the seeds germinating while still on the plant.

Waxy—Resembling beeswax in appearance or consistence.

Wing—Any membranous or thin expansion or appendage; the lateral petal of a papilionaceous flower.

Wood—The hard, firm part of a stem, etc., composed mainly of wood cells (fibro-vascular tissue).

Woolly—Clothed with long and twisted or matted hairs.

INDEX TO ILLUSTRATIONS.

Page.
Actinonema rosæ 251
Aleyrodes scale 211
Aleyrodes scale parasite 285
Ambiguous ladybird 274
Anarsia lineatella 230
Anthonomus quadrigibbus 228
Apricot scale 198
Aphelinus fuscipennis 283
Apple curculio 228
Apple or woolly aphis 214, 215
Arbutus unedo 139
Aramigus fulleri 227
Ashy gray ladybird 273
Aspidiotus nerii 169, 170
Aspidiotus aurantii 163
Aspidiotus rapax 173
Aspidiotus perniciosus 171
Australian ladybird. (See Plate IV.)

Black scale 195-196
Black scale parasite 281
Blood-red ladybird 275
Budding the walnut 137
Brown apricot scale 198
Brown or soft orange scale 194
Brown or soft scale parasite 285
Brown neck ladybird 277

California ladybird 276
Camellia scale 191
Canatrachelus nenuphar 223
Carpocapsa pomonella 219, 220, 221
Ceroplastes cirropediformis 189
Ceroplastes floridensis 186
Cherry or pear slug 216
Chilocorus bivulnerus 272
Chrysopa (unnamed) 278
Cochenille insect 209
Codlin moth 219, 220, 221
Common mealy bug 203
Conotrachelus crataegi 228
Convergent ladybird 275

Page.
Cosmocoma elegans 288
Cottony cushion scale 208
Cottony maple scale 190
Coccinella oculata, var. abdominalis 273
Coccinella sanguinea 275
Coccinella transversoguttata 276
Coccotorus scutellaris 229
Coccophagus cognatus 285
Coccus cacti 209

Dactylopius adonidum 203
Dactylopius destructor 204
Dactylopius longifilis 206
Devil's horse or wheel bug 280
Destructive mealy bug 204
Diabrotica soror 218
Diabrotica tri-vittata 218
Diaspis carueli 175
Diaspis rosæ 176
Dilophogaster californica 281

Eyed ladybird 273
Exachomous pilatei 272
Fig, The. Arrangement of trays 129
Fig, The. Cutting; different methods 132
Fig, The. Germs of 115
Fig, The. Pruning 133-134
Fig, The. Six-year old orchard 135
Florida barnacle scale 189
Florida red scale 166
Florida red scale (Limacis) 286
Florida wax scale 186
Fuller's rose beetle 227

Greedy scale 173
Gyrolasia flavimedia 285

Hemisphærical scale 192
Hippodamia ambigua 274
Hippodamia convergens 275

Icerya purchasi 208

Juniper scale 175

Lace-winged fly 278
Leaf caterpillar 216
Lecanium hesperidum 194
Lecanium hemisphæricum 192
Lecanium oleæ 195, 196
Limacis aspidioticola 286
Live oak scale 200
Long or Glover's scale 183
Long-thread mealy bug 206

Page.
Minute scymnus 276
Mytilaspis citricola 180
Mytilaspis gloverii 183
Mytilaspis pomorum 184

Nemantus (leaf caterpillar) 216
Notodonta concinna 222
Norfolk Island pine scale 201

Oleander scale 169, 170
Olive—Ascolona 88
Olive—Belmonte 85
Olive—Cleft grafts 102
Olive—Eye buds 107, 108
Olive—Indoor grafting 105
Olive—Gremignola 90
Olive—Giogliaia 82
Olive—Leccia 84
Olive—Olivastria 92
Olive—Orchard grafted 100
Olive—Razza 88
Olive—Rossillina 89
Olive—Santa Caterina 83
Olive—St. Agostino 85
Olive—Twig buds 106
Olive—Tree, grafted 101
Olive—Trilla 91
Oyster-shell apple scale 184

Peach borer 230
Peach moth 229
Pear-blight beetle 230
Pear cracking and leaf blight 235, 237
Pentilia coccidivora 276
Pernicious scale 171
Phragmidium mucronatum 248
Pilate's ladybird 272
Plum curculio 223
Plum gouger 229
Polycaon confertus 231
Prionidus cristatus 280
Psyllobora 20-maculata 277
Pulvinaria camellicola 191
Pulvinaria innumerabilis 190
Purple scale 180

Quince curculio 228

Red humped caterpillar 222
Red orange scale 163
Red spider 232
Rhizoccus araucariæ 201
Rose leaf black spot 251

PAGE.
Rose rust 248
Rose scale 176

Sannania pacifica 229
San José scale parasite 283
Selandria cerasi 216
Schizoneura lanigera 214, 215
Scymnus marginicollis 277
Sphærella fragariæ 254
Spotted psyllobora 277
Syrphus flies 279
Strawberry leaf blight 254
Strawberry tree 139
Striped squash beetle 218

Tetranychus telarius 232
Tetranychus (unnamed) 233
Tree planting—systems 149
Twelve-spotted diabrotica 218
Twice-stabbed ladybird 272
Twig borer 231

Walnut budding 137

Xyleborus pyri 230

Yellow spider or mite 233

GENERAL INDEX.

A

PAGE.
ACTINONEMA ROSÆ 250
ADORATA—Olive 89
ADULTERANTS—Millian process for detecting 114
  New process for detecting 112
  Oil 109-111
ADDRESS—Hon. Ellwood Cooper, Tenth Convention 289
  Eleventh Convention 328
  Twelfth Convention 383
ADDRESS OF WELCOME—Rev. E. Graham 291
  Mrs. Flora M. Kimball 331
  E. J. Griffith 387
AIKEN, HON. W. H.—Elected Vice-President 383
  Report for Committee 446
AGRICULTURE—Secretary of 263
AGUILIFOLIUS OSMANTHUS 92
ALBA DULCIS—Olive 90
ALEYRODIDÆ 210
ALEYRODES SCALE 210
  Parasite of 285
ALMONDS 8
AMARGINATA—Olive 92
AMBIGUOUS LADYBIRD 274
AMERICANA—Olive 90
AMYGDALINA—Olea 89
ANALYSIS—Soil 46
ANARSIA LINEATELLA 230
ANGULOSA—Olive 89
ANTHONOMUS QUADRIGIBBUS 228
APETALA—Olive 92
APHELINUS FUSCIPENNIS 283
  Genus 282
APHIDIDÆ—Propagation of 212
  Features of 212
APHIS-LIONS (so called) 278
APPLE—Aphis 214-215
  Curculio 16
APPROPRIATION 16
ARAMIGUS FULLERI 227
ARBOREA—Olive 92
ARBUTUS UNEDO 139
ASHY GRAY LADYBIRD 273
ASCOLONA—Olive 88
ASPIDIOTUS—Aurantii 163
  Convexus 174
  Ficus 166
  Juglans regiæ 167
  Nerii 169
  Rapax 173
  Perniciosus 170
ATRO-RUBENS—Olive 89
ATRO-VIALACEA—Olive 99
ATRO-MIRENS—Olive 89
AUSTRALIAN LADYBIRD 267

B

BANDS 221
ARNACLE SCALE 188
BEAN SPRAY PUMP 8

PAGE.
BELMONTE—Olive 85
BELLA DI SPAGNA—Olive 88
BENEFICIAL INSECTS—Introduction of 260
BERGER, H. H.—Essay by 355
BILLS—Assembly 16
  Senate 15
BLACK SCALE 195
  Parasite of 281
  Remedy for 197
BLACK SPOT—Rose leaf 250
BLIGHT—Strawberry leaf 253
  Development of 255
  Treatment 258
BLOSSOMS—Effect of rain 357
BOARD—State Horticulture, extracts from meeting 464
BOARD OF TRADE—Fresno, vote of thanks to 463
BASILICATA—Varieties of olives in 87
BASIN OF GARDA—Varieties of olives in 87
BOUTEILLAC—Olive 90
BOUTINIANE—Olive 90
BOX, ORANGE—Size of 143
BLOCK, A.—Remarks by, on freight rates 321
BLOOD-RED LADYBIRD 275
BRADSTREET—Announcement from 7
BRAINARD, H. A.—Essay by 358
BRESCIA—Varieties of olives in 87
BROWN APRICOT SCALE 198
  Remedy for 199
BROWN ORANGE SCALE 193
  Remedy for 194
BROWN NECK LADYBIRD 277
BUCK, HON. L. W.—Remarks by, on coöperation 450
  Fruit packing 348
  Marketing fruits 446
BUDDING—Eye 107
  Improved method 108
  Twig 106
  The olive 100
BURR, LOUIS W.—Essay by 390
BUTLER, P. W.—Essay by 296
BUTTE COUNTY—Growing oranges in 323

C

CALABRIA—Varieties of olives in 87
CALIFORNIA LADYBIRD 276
CALKINS, C. G.—Essay by 448
CAMELLIA SCALE 191
  Remedy for 192
CAMPHOR TREE 355-356
CAPENSIS—Olive 90-92
CARPOCAPSA POMONELLA 219
CEROPLASTES CIRROPEDIFORMIS 188
  Floridensis 186
CITRIC ACID 146
CITRUS CULTURE 323
  Trees—Resin spray on 420
  Fruits—Scale of points for judgment of 365
CHAMBER OF COMMERCE (L. A.)—Letter from 442
CHAPMAN, A. S.—Letter from 283, 396-397
CHEMICAL STUDY—The olive 46
CHERRY, THE—Climate for 300
  Culture of 300
  Cultivation of 301
  Mildew of 243
  Powdery mildew 243
CHERRY OR PEAR SLUG 217
CHERRY, PEACH, and PLUM RUST 242
CHILOCORUS BIVULNERUS 271
CHIONASPIS—Genus 177
CHIONASPIS PINIFOLIÆ 177
CHIONASPIS QUERCUS 178
CHIONANTHUS 41
CHIPMAN, GEN. N. P.—Essay by 305

PAGE.
CHRYSOPA 278
CHRYSOPHYLLA—Olive 92
COCCIDÆ—Division of 157
  Organs of 162
  Metamorphoses of 157
COCCINELLA—Genus 284
  Oculata 273
  Coccinellidæ 265
  Convergent 275
  Eyed 273
  Pilates 272
  Sanguinea 275
  Twice stabbed 271
COCCUS CACTI 209
COCCOTORUS SCUTELLARIS 229
  Conatus 284
COCHENILLE INSECT 209
CODLIN MOTH 219
  Remedy for 220
COLMAN, HON. N. J.—Letter from 261, 262
COLUMELLA—Olive 94
COMMISSIONERS, COUNTY—Reports from 477
COMMON MEALY BUG 202
  Remedy for 204
COMSTOCK, PROF. J. HENRY 155
CONDITION OF STATE 5
CONGER, O. H.—Essay by 361
CONGRESS—Memorials to 441, 446, 462
CONVENTIONS—Tenth, proceedings of 289
  Eleventh, proceedings of 328
  Twelfth, proceedings of 383
CONVERGENT LADYBIRD 275
CONVEX OR WILLOW SCALE 174
COTTONY CUSHION SCALE 207
  Remedy for 208
COTTONY MAPLE SCALE 190
COQUILLETT, PROF. D. W.—Essay by 333, 394
COUNTY HORTICULTURAL COMMISSIONS—Reports from 477
  Alameda County Board 477
  Colusa County Board 479
  Humboldt County Board 481
  Kern County Board 484
  Los Angeles County Board 485
  Mendocino County Board 486
  Nevada County Board 487
  San Benito County Board 493
  San Bernardino County Board 489
  San Joaquin County Board 495
  San Mateo County Board 497
  Santa Barbara County Board 488
  Sutter County Board 499
  Ventura County Board 500
COOKE—The late Matthew 441
COOPER, HON. ELLWOOD—Address by 289, 328, 383
  Essay on the olive 341
  Pruning 338
  Reëlected President 446
COOPER, MRS. ELLWOOD—Essay by 425
  Vote of thanks to 428
COOPERATION OF FRUIT GROWERS 448
CRAW, ALEXANDER 260
CULTIVATION 84, 338
CUTTER, J. E.—Essay by 365

D

DACTYLOPIUS DESTRUCTOR 204
  Genus 202
  Longifilis 206
DE LONG, HON. F. C. 15
DESTRUCTIVE MEALY BUG 204
DEVIL'S HORSE OR WHEEL BUG 279
DIABROTICA SOROR 218
  Tri-vittata 217

Page.

- DIASPIS CARUELI 175
  - Genus 174
  - Rosæ 176
- DILOPHOGASTER CALIFORNICA 281
- DISEASES—Fungoids 235
  - Remedies for 468
  - The vine 434
- DOBBINS, J. R.—Letter from 396
- DYKE, T. S. VAN—Essay by 376

E

- ELEME 117
- EMARGINATA—Olive 91
- ENTOMOSPHORIUM MACULATUM 235
- EXASPERATA—Olive 91
- EXCELSA—Olive 91
- EXECUTIVE COMMITTEE 20
- EXHIBITION—Report of committee 350
- EXOCHOMUS PILATEI 272
- EXPLANATION OF PLATES 266
- EYED LADYBIRD 273
- EYE—Budding 107
  - Grafting 104

F

- FERRUGINEA—Olive 92
- FICUS CARICA 115
- FIG—The 115
  - Asporkoukouzza 125
  - Brianzosi 116
  - Brogiotti 116
  - Culture of 116, 401
  - Curing, the process 126, 128
  - Cuttings 132
  - Datteri 117
  - Dottati 117
  - Drying 118, 126, 129
  - Flowers of 115
  - Formation of tree 134
  - Fruit setting 136
  - Fruits of 115
  - Gentile 116
  - Liviani 116
  - Napoli 117
  - Orchard 135
  - Ottato 117
  - Politika 118
  - Pompeiiani 116
  - Preparation of 118
  - Production of 135
  - Propagation of 132
  - Pruning 133
  - San Piero 117
  - Seed of 115
  - Setting of the fruit 136
  - Suckers 132
  - Varieties 115
  - Verdini 116
  - White Adriatic 115
  - White fig (Fico Albo) 117
- FIGS—Extracting ardent spirits from 126
- FLORAL CULTURE 324
  - Discussion on 327, 428
  - Essay by Mrs. Ellwood Cooper 425
- FLORIBUNDA—Olive 92
- FLORIDA BARNACLE SCALE 188
  - Food plants 188
- FLORIDA RED SCALE 166
  - Remedy for 167
  - Limacis (Parasite) 286
- FLORIDA WAX SCALE 186
  - Food plants 188

Page.

- FORD, PROF. H. C.—Essay on Palms, etc. 366
- FORESTS—Protection of 461
- FORMATION OF TREE 134
- FORSYTHIA 41
- FRAGRANS—Olive 92
  - Osmanthus 91
- FRANTOIAMI 84
- FRAXINEÆ—Sub-tribe 41
- FRAXINUS FONTANESIA 41
- FREEMAN, GEO. E.—Essay by 435
- FRESNO, THE PEOPLE OF—Resolution thanking 463
  - County—Fruit culture in 435
- FRUIT—Drying of 411
  - Packing of 348
  - Pests and their extermination 390
  - Production of 135
  - Setting of 136
- FRUIT CULTURE—Discussion on 428
  - In Fresno County 435
- FRUIT DRYING—Discussion on 412
- FRUIT GROWERS—Conventions of 289
  - Coöperation of 448
- FRUIT GROWING IN CALIFORNIA 310
- FRUIT PESTS 390
- FRUIT SHIPMENTS—1888–89 6
- FRUITS—Citrus 6
  - Deciduous crop 1888 6
  - Imported 8
  - Imports of 315
  - Packing, discussion on 446
  - Picking, discussion on 446
  - Shall we can or dry? 318
  - Storing, discussion on 446
  - Sun-drying 448
- FULLER'S ROSE BEETLE 227
  - Remedy for 228
- FUNGOID DISEASES 235

G

- GALLINSECTES 156
- GARDENIA 92
- GAS, HYDROCYANIC ACID 165
- GASPARINI, PROF.—Report on Caprification 402
- GEDNEY, JAMES E.—Essay on "Cherry Culture" 300
- GIOGILIAIA—Olive 82
- GLOSSARY—Botany 509
  - Entomology 507
- GOULD, DR. F. L.—Experiments in growing olives from seed 78
- GOVERNOR OF STATE—Report to 5
- GRAFTING 100
  - Cleft 100
  - Crown 102
  - Eye 104
  - Indoor 105
  - Insertion of shield 104
  - Preparation of shield 104
  - Ring 105
  - The olive 100
  - Walnut 138
  - When performed 100
- GRAHAM, REV. E.—Address of welcome by 291
- GRAPES—Raisin 430
  - Wine 7
- GRAY, G. M.—Elected Vice-President 289
- GREEDY SCALE—Remedy for 174
- GRIFFITH, E. J.—Address of welcome by 387
- GROUND—Laying out 150
- GROWING FROM SEED—Olive 78
- GUAVA—The 8
- GYROLASIA—Genus 285
- GYROLASIA FLAVIMEDIA 285

H

PAGE.

- HALLAHAN, MISS ELLA—Appointed Clerk 467
- HEACOCK, HON. E. H. 15
- HEARST, HON. GEORGE—Letter from 264
- HEMISPHÆRICAL SCALE 192
  - Remedy for 193
- HIPPODAMIA AMBIFUA 274
- HOLT, L. M.—Essay by 345
- HORTICULTURAL COMMISSIONS—List of 505
- HUGHES, E. H.—Vote of thanks to 463
- HYDROCYANIC ACID GAS 165

I

- ICERYA—Genus 207
  - Purchasi 207
- ILICIFOLIA—Olive 92
- INDOOR GRAFTING 105
- INJURIOUS INSECTS 155, 333
- INSECT PESTS 293
  - Discussion on 296, 337, 393, 397
  - Essay by H. P. Stabler 293
  - Nature's methods of subduing 394
  - Remedies for 333
- INSECTS—Beneficial 260
  - Injurious 155
  - Scale 155
- INTRODUCED OLIVE VARIETIES 93
- INTRODUCTION OF PARASITES 21
- IRRIGATION 345

J

- JAPAN—Olive from 91
- JAPANESE NUTS 355
- JAPONICUM LEGUSTRUM 92
- JASMINACEÆ 40
- JOHNSTON, HON. WM.—Elected Vice-President 289
- JUNIPER SCALE 175
  - Remedy for 176

K

- KELLOM, J. H.—Essay by 420
- KELLS, R. C.—Essay by 318
- KEOBELE, ALBERT 262
  - Aid from 155
- KERMES—Genus 199
- KIMBALL, MRS. FLORA M.—Address of welcome by 331

L

- LACE-WINGED FLIES 278
- LADYBIRDS 265
  - Ambiguous 274
  - Ashy gray 273
  - Brown neck 277
  - California 276
  - Coccinellidæ 265
  - Convergent 275
  - Eyed 273
  - Pilate's 272
  - Sanguinea 275
  - Twice stabbed 271
- LEAF BLIGHT—Development of 255
  - Strawberry 253
- LEAF CATERPILLAR (Nemantus) 215
  - Remedy for 216
  - Spot (Rose) 250
- LECANIÆ—Sub-family 186
- LECANIUM HESPERIDUM 193
  - Hemisphæricum 192
  - Olea 195
  - Persicæ 199
- LEGUSTRUM, JAPONICUM 92

PAGE.

- LELONG, B. M.—Reëlected Secretary 466
  - Remarks on the fig 407
  - Remarks on the olive 443
  - Report April 15, 1889 14
  - Report November 4, 1889 18
  - Report, supplement to 25
  - Thanks to 289
- LEMON, THE—Commercial classification of 145
  - Culture of 361
  - Curing of 364
  - Cuttings vs. seedlings 363
  - Grading of 145
  - Grown where 6
  - Setting of fruit 361
  - Shipments 6
  - Soil for 362
  - Transplanting of 362
- LENOCARPA—Olive 89
- LIGURIA—Olive varieties in 87
- LINOCIERA NOTELÆA 41
- LIVE OAK SCALE 199
  - Remedy for 200
- LONG OR GLOVER'S SCALE 182
  - Habitat 184
- LONG THREAD MEALY BUG 206
  - Remedies for 207
- LUCQUES—Olive 97

M

- MACHINERY, HORTICULTURAL 358
- MACROCARPA—Olive 90
- MADEIRA—Olive tree from 91
- MANDARIN—Oranges 144
- MANZANILLO—Olive 98
- MAPLE SCALE 190
- MARKETING FRUITS—Discussion on 321, 446
- MASLIN, HON. E. W.—Essay by 401
  - Remarks by 461
- MEALY BUGS 3, 4, 6, 202
- MEMORIALS—To Congress 260, 441, 446
  - Acknowledgments of 264
  - On insects 260
  - Protection of forests 462
- MILES, FRED. C.—Essay by 360
- MILDEW—Botanical characters 245
  - Cherry powdery 243
  - Internal characters 244
  - Treatment 246
- MILLIAN—Process of detecting adulterants 114
- MINUTE SCYMNUS 276
- MISSION OLIVE 99
- MORROW, HON. W. W.—Letter from 265
- MOSHER, J. L.—Elected Auditor 466
- MOTHERAL, N. W.—Elected Special Agent 468
  - Resignation 470
  - Synopsis of reports 472
  - Vote of thanks to 470
- MYRMELION 279
- MYSTERIOUS VINE DISEASE 434
- MYTILASPIS CITRICOLA 179
  - Genus 179
  - Gloverii 182
  - Pomorum 184
- MYXOPGRUM LEGUSTRUM 41

N

- NATHUSIA 41
- NEPUGETE—Olive 90
- NESBIT, F. C.—Letter from 371
- NIGRA DULCIS—Olive 90
- NORFOLK ISLAND PINE SCALE 201
- NORTH, J. W.—Elected Vice-President 383

PAGE.
NORTONHED CERANTHUS 41
NOTILDEA 41
NOTODONTA CONCINNA 222
NURSERY POTS—Growing olives in 77
NUT TREES, JAPANESE 355

O

OAK SCALE 178
  Parasites of 288
  Remedy for 179
ODORIFEROUS OSMANTHUS 91
OFFICERS—Roster of kindred societies 502
OLEA—Alba dulcis 90
  Americana 25, 42, 90
  Amygdalina 89
  Angulosa 89
  Apetala 90, 92
  Arborea 92
  Atro-rubens 89
  Atro-virens 89
  Bouteillac 90
  Capensis 90
  Carpensis 92
  Chion-carpa 89
  Chrysophylla 92
  Colombaro 89
  Emarginata 91
  Europeæ 25
  Exasperata 91
  Excelsa 91
  Floribunda 92
  Forestiera 41
  Fragrans 91, 92
  Furruginea 92
  Genus 42
  Glandulifera 38
  Ilicifolia 92
  Laurifolia 42
  Lenocarpa 89
  Nepugete 90
  Nigra dulcis 90
  Oblonga 89
  Paniculata 25
  Pendulina 99
  Praecox 90
  Reispanica 89
  Rubra 92
  Serratifolia 92
  Spherica 90
  Viridula 90
OLIVE, THE—Adorata 90
  Absorption of minerals, mode and principle 53
  Agrostino 85
  Alba dulcis 90
  Americana 90
  Amygdalina 89
  Analysis of 109
  Analysis of the ashes 48, 55
  Analysis of composition of ashes 49
  Analysis of fruits 48
  Analysis of composition of fruits 49
  Analysis of the endocarp 51
  Analysis of the kernels 52
  Analysis of the leaves 48
  Analysis of the composition of leaves 49
  Analysis of pulp 51
  Analysis of absorption of roots 53
  Analysis of the soil 46
  Analysis of tannin in bark 50
  Analysis, measurement of tannin in bark 50
  Analysis of the wood 48
  Analysis of ashes of the wood 49
  Analysis of oil cake 55, 61

PAGE.
OLIVE, THE—Analysis of ashes of oil cake 61
  Apetala 90, 92
  Arborea 92
  Ascolona 88
  Atro-vialacea 99
  Atro-virens 89
  Basilicata 87
  Bella di Spagna 88
  Belmonte 85
  Botanical study 27
  Boutiniane 90
  Calabria 87
  Carpensis 92
  Chemical study 46
  Chion-carpa 89
  Chrysophylla 92
  Climate and abode 62
  Climate and soil adapted to 7
  Colombaro 89
  Columella 94
  Cultivation of 84
  Culture of 341
  Discussion on 342, 442
  Emarginata 91
  Exasperata 91
  Excelsa 91
  Ferruginea 92
  Floribunda 92
  Frantoiani 84
  Genus 25
  Giogliaia 82
  Ilicifolia 92
  Leccia 84
  Lecocarpa 89
  Life of 67
  Liguria 87
  Lucques 97
  Manzanillo 94
  Macrocarpa 94
  Medium 84
  Mission 99
  Nigra dulcis 90
  Oblonga 89
  Odoriferous 91
  Oleaster 84
  Oliviere 96
  Osmanthus aquilifolius 92
  Osmanthus fragrans 91
  Pendoulier 99
  Picholine, the 93
  Picholine, the Redding 93
  Pigale 97
  Praecox 90
  Propagation 73
  Propagation by seed 75
  Propagation by the seed bed 76
  Propagation by growing from seed 78
  Propagation by pits grown spontaneously 79
  Propagation by ovule 79
  Propagation by nursery pots 77
  Propagation indirect 79
  Puglia 87
  Punchude 89
  Racemosa 90
  Regia 90
  Rossellina 89
  Rouget 95
  Rubra 92, 98
  Saillern 94
  Santa Caterina 83
  Sativa 43
  Saurine 89
  Sarratifolia 92
  Sicily 87

PAGE.

- OLIVE, THE—Spherica 90
  - Subrotunda 90
  - Sylvestris 43
  - Temperature 85
  - Tuscany 86
  - Umbria 87
  - Uvaria 94
  - Variegata 90
  - Varieties 81
  - Varieties in Tuscany 85
  - Vegetation of 67
  - Vegetation and life of 67
  - What it can produce 54
  - Wild 84
- OLEACEÆ AND THE OLIVE 25
- OLEACEÆ—Order 25
- OLEANDER SCALE—Remedy for 169, 170
- OLEASTER 43
  - Ornamental tree 25
- OLEASTERS 84
- OLEINEÆ 40
- OLIVASTRI 84
- OLSEÆ 40
- OSMANTHUS 41, 91, 92
- ORANGE, THE 323
  - Culture of 360
  - Growing of 323
  - Mandarin 144
  - Packing 141
  - Scale, aspidiotus aurantii 163
  - Shipments 6
  - Standard box 143
  - Standard counts 144
  - Tangerine 144
  - Where grown 6
- ORCHARD—Arrangement of 147, 148
  - Fig 135
- OYSTER SHELL OR APPLE SCALE 184
  - Habitat 185
  - Remedy for 185

P

- PACKING—Oranges 141
- PALM—Date 369
  - Fertilization of 370
  - Washington 368
- PALMS—Ornamental, etc. 366
- PAPARELLI, LOUIS—Chemical study by 46
- PARASITE—Aleurodes scale 285
  - Black scale 281
  - Brown or soft orange scale 284
  - Oak scale 288
  - Red scale 284
  - San José scale 283
- PARASITES—Introduction of 21, 260, 384, 385
  - Resolutions 261, 262, 263, 264
  - True 281
- PARIS GREEN 220
- PARKER, H. E.—Remarks by 405
- PEACH, THE—Canning and drying 299
  - Cultivating 297
  - Culture of, essay by P. W. Butler 296
  - Fertilizing 297
  - Irrigation 298
  - Picking and packing 298
  - Planting 297
  - Popular fruit 6
  - Pruning 297
  - Varieties to plant 296
- PEACHES—Crop of 299
  - Profit in 299
- PEACH BORER 229
  - Remedy for 229

PAGE.

- PEACH MOTH OR TWIG BORER 230
  - Remedy for 230
- PEANUTS 8
- PEAR BLIGHT BEETLE 230
  - Remedy for 231
- PEAR CRACKING AND LEAF BLIGHT—External characters 238
  - Microscopic characters 239
  - Treatment 240
- PEAR SLUG 216
  - Remedy for 217
- PEAR, THE—Fresh, canned, and dried 7
- PECK, REV. N. R.—Reëlected Vice-President 466
- PENDOULIER—Olive 99
- PENDULINA—Olive 99
- PENTILIA COCCIDIVORA 276
- PERNICIOUS SCALE 170
- PERSIMMON, JAPANESE 8
- PHILLYREA 41
- PHRAGMIDIUM MUCRONATUM 247
- PICHOLINE—Olive 93
  - Redding 93
- PIGALE—Olive 97
- PIGNOLO—Olive 89
- PILATE'S LADYBIRD 272
- PINE SCALE 177
  - Remedy for 178
- PLANTING 147
- PLANTING TREES 153
  - Recommendations 154
- PLATES—Explanation of 266
- PLUM CURCULIO (Eastern) 223
  - Remedy for 227
- PLUM GOUGER 229
- PLUM SCALE 199
  - Remedy for 199
- PODOSPHÆRA OXYCANTHA 243
- POLYCAON CONFERTUS 231
- PORPHYROPHORA POLONICA 162
- PRAECOX—Olive 90
- PRIONIDUS CRISTATUS 279, 280
- PRODUCT OF STATE 5
- PROPAGATION OF THE OLIVE 73
  - Indirect 79
  - Nursery pots 77
  - Old trunk 74
  - Ovule 74, 79
  - Ramified slips 80
  - Seed bed 76
  - Seed 74
  - Simple and ramified slips 74, 80
  - Sprouts 74
  - Suckers 81
  - Wild olive 74
- PROTECTION OF FORESTS 461
- PRUNE, THE—Drying 6
  - Growing 6
- PRUNING—Discussion on 303, 339, 454
  - The fig 133
- PRUNING AND CULTIVATION 338
- PSYLLOBORA (20-MACULATA VAR.) TÆDATA 277
- PUCCINIA PRUNI-SPINOSÆ 242
- PUGLIA—Varieties of olives in 87
- PULVINARIA CAMELLICOLA 191
  - Genus 190
  - Innumerabilis 190
- PUNCHUDE—Olive 89
- PURPLE SCALE 179
  - Habitat 182

Q

- QUINCE CURCULIO 228

R

PAGE.
RACEMOSA—Olive ... 90
RAILROAD RATES—Committee on ... 441, 442
RAIN—Effect on blossoms ... 357
RAINFALL ... 347
RAISIN GRAPE ... 430
RAISINS—California ... 6
RATES—Committee on ... 441, 442
RAZZA—Olive ... 88
REDDING PICHOLINE—Olive ... 93
RED-HUMPED CATERPILLAR ... 222
    Remedy for ... 222
RED ORANGE SCALE ... 163
    Remedy for ... 165
RED SCALE, THE ... 420
    Of Florida ... 166
    Parasite ... 284
RED SPIDER ... 232
    Remedy for ... 233
REGIA—Olive ... 90
REGULATIONS ... 468
REISPANICA—Olive ... 89
REMEDIES—Insect pests ... 333, 334, 468
REPORT—For 1889 ... 20
    Secretary, April 15, 1889 ... 14
    Treasurer, November 4, 1889 ... 9–12
REPORTS—Treasurer ... 9–12
RESIN SPRAY ... 421, 422, 423
    Effects on citrus trees ... 420
RESOLUTIONS ... 381, 382
    Adopted Fresno meeting ... 463
RESOURCES OF CALIFORNIA—Southern California ... 376
RHIZOCOCCUS ARAUCARIÆ ... 201
RICE, GEO.—Election to office ... 467
    Remarks on coöperation ... 451
RING GRAFTING ... 105
RIVES, HON. G. L. ... 261, 262
ROSE-LEAF BLACK SPOT ... 250
ROSE SCALE ... 176
    Remedy for ... 177
ROSE, THE—Rust of ... 247
ROSSELLINA—Olive ... 89
ROSTER OF OFFICERS—Kindred societies, etc. ... 502
    National ... 502
    State and county ... 504, 505
ROUGET—Olive ... 95
ROWLEY, B. N.—Essay by ... 448
RUBRA—Olive ... 92, 98
RUNYON, SOL.—Elected Treasurer ... 467
RUST—Cherry ... 242
    Peach ... 242
    Plum ... 242
    Rose—Characters of ... 247
    Rose—Treatment of ... 250

S

SAILLERN—Olive ... 94
SALVADORA, AZYMA, DOBERA ... 42
SALVADORACEÆ ... 41
SAN JOSÉ SCALE—Remedy for ... 172
    Parasite ... 283
SANNANIA PACIFICA ... 229
SANTA CATERINA—Olive ... 83
SAURINE—Olive ... 89
SCHREBERA—Olive ... 41
SCYMNUS MARGINICOLLIS ... 277
    Minute ... 276
SECRETARY'S REPORT OF—Consulates ... 19
    Finances ... 14
    Horticultural Commissions ... 19
    Legislation ... 15
    Memorials ... 19
    Publications ... 14, 18

PAGE.
SECRETARY'S REPORT OF—Quarantine Guardians ... 15, 19
    Supplement to ... 25
SECRETARY'S REPORT—April 15, 1889 ... 14
    Supplementary ... 25
    November 4, 1889 ... 18
SEED BED—Olive growing ... 76
SELANDRIA CERASI ... 216
SERRATIFOLIA—Olive ... 92
SHANAHAN, HON. T. W. H. ... 16
SHIELD GRAFTING ... 104
SICILY—Varieties of olives in ... 87
SMALL STOCKS—Grafting ... 100
SMITH, E. E.—Essay by ... 324
SMITH, W. W.—Remarks by ... 320
SMYRNA FIGS ... 401
    Seedlings ... 401
SOAP—Art of making ... 234
SODA-RESIN SOLUTION ... 421, 422, 423
SOIL—Analysis of ... 46, 47
    Preparation of ... 148
SPECIAL AGENT—Synopsis of reports ... 472
SPHERICA—Olive ... 90
SPHÆRELLA FRAGARIÆ ... 253
SPOTTED PSYLLOBORA ... 277
STABLER, H. P.—Essay by ... 293
STATE BOARD OF HORTICULTURE—Extracts from meetings ... 464
STANFORD, HON. LELAND—Letter from ... 265
STRAWBERRY TREE ... 139
STRIPED SQUASH BEETLE ... 217
STORKE, HON. E. A. ... 15
ST. AGOSTINO—Olive ... 85
SUBROTUNDA—Olive ... 90
SUCKERS—Olive ... 81
SULPHUR—Use of ... 131
SUN-DRYING FRUITS ... 448
SYRINGA—Genus ... 41
SYRPHUS FLIES ... 279

T

TANGERINE—Oranges ... 144
TEMPERATURE—Olive growing ... 70
TETRANYCHUS TELARIUS ... 232
    (Unnamed) ... 233
THANKS, VOTE OF—To Legislature ... 17
THUMB—Olive ... 91
THURBER, H. K.—Letter on the fig ... 403
TOMPKINS, GILBERT—Essay by ... 357
TRAYS—Arrangement of ... 129
TREASURER'S REPORT—April 15, 1889 ... 9
    November 4, 1889 ... 12
TREE PLANTING ... 147
    Care before planting ... 153
    Distance apart ... 151, 152
    Planting of ... 153
    Quincunx system ... 149
    Square system ... 149
    Triangular system ... 149
    When to plant ... 147
TUSCANY—Varieties of olives in ... 85, 86
TWICE-STABBED LADYBIRD ... 271
TWIG BUDDING ... 106
TWELVE-SPOTTED DIABROTICA ... 218
    Remedy for ... 218
TWIG BORER—Polycaon confertus ... 231
    Remedies for ... 232

U

UMBRIA—Olive varieties in ... 87
UVARIA—Olive ... 94

V

PAGE.

VALLEJO, GEN. M. G.—Report, April 15, 1889 ... 9
VARIEGATED OLIVES ... 90
VARIETIES—Olives ... 81, 85, 93
VEDALIA CARDINALIS ... 260, 267, 269
VEGETATION—Olive growing ... 67
VERONA—Olive varieties in ... 87
VINTAGE, CALIFORNIA, FOR 1889 ... 7
VIRIDULA—Olive ... 90

W

WALNUT, THE ... 137
  Budding ... 137
  Grafting ... 137
  Prong grafting ... 138
  Scale ... 167
  Scale, remedy for ... 168
WATERMAN, GOV. R. W.—Report to ... 5
WATER SOURCES, PROTECTION OF ... 345
WELCOME—Address ... 291, 331, 387
WHEAT GROWING IN CALIFORNIA ... 305
WHEAT vs. FRUIT—Essay by Gen. N. P. Chipman ... 305
WHEEL BUG, OR DEVIL'S HORSE ... 279, 280
WHITE, T. C.—Essay by ... 430
WILLOW SCALE ... 174
WOOD, JESSE—Remarks by ... 323
WOOLLY OR APPLE APHIS ... 214
  Remedy for ... 215
XYLEBORUS PYRI ... 230
YELLOW SPIDER ... 233
  Remedy for ... 233

ERRATA.

Page 117, line 29, next to "Elemi" read "resin," instead of "raisin."
Page 345, heading, read "Irrigation and Protection," etc., instead of "Irrigation and Production," etc.

CALIFORNIA STATE MINING BUREAU.

WILLIAM IRELAN, Jr., State Mineralogist.

NINTH ANNUAL REPORT

OF THE

STATE MINERALOGIST,

FOR THE

YEAR ENDING DECEMBER 1, 1889.

SACRAMENTO:
STATE OFFICE : : : : J. D. YOUNG, SUPT. STATE PRINTING.
1890.

TABLE OF CONTENTS.

PAGE.
Accounts from October 1, 1888, to October 1, 1889 ... 11
Auriferous gravels of California, by John Hays Hammond, E.M. ... 105–138
Barnes, Geo. E.—Meteorological ... 312–322
Bowers, Dr. Stephen—Report on San Nicolas Island, Ventura County ... 57–61
California cemen ... 309–311
Channel Islands, report on, by Dr. Lorenzo G. Yates ... 171–188
Clays, by W. D. Johnston, M.D. ... 287–308
Coal product of California ... 323
Cooper, Dr. J. G.—Value of fossils as indications of important mineral products ... 248–286
Crossman, James H.—Report on San Bernardino County ... 214–239
De Groot, Dr. Henry—Manufacture of glass in California ... 324–329
Dunn, R. L.—River mining ... 262–281
Geological Survey of California—Report by Harry I. Willey ... 40–45
Goodyear, W. A.—Report on Santa Cruz Island ... 155–170
Goodyear, W. A.—Report on San Diego County ... 139–154
Gumbinner, Sven—Refining and coining of precious metals ... 62–104
Hammond, John Hays, E.M.—Auriferous gravels of California ... 105–138
Irelan, Linna—Pottery ... 240–261
Johnston, W. D., M.D.—Clays ... 287–308
Lassen County, Cal.—Report by E. B. Preston, E.M. ... 211–213
Los Angeles County, Cal.—Report by E. B. Preston, E.M. ... 189–210
Manufacture of glass in California, by Dr. Henry De Groot ... 324–329
Meteorological, by Geo. E. Barnes ... 312–322
Mineral products of the United States ... 330–339
Pottery, by Linna Irelan ... 240–261
Preston, E. B., E.M.—Report on Los Angeles County ... 189–210
Preston, E. B., E.M.—Report on Lassen County ... 211–213
Refining and coining of precious metals, by Sven Gumbinner ... 62–104
River mining, by R. L. Dunn ... 262–281
San Bernardino County—Report by James H. Crossman ... 214–239
San Diego County—Report by W. A. Goodyear ... 139–154
San Nicolas Island, Ventura County, by Dr. Stephen Bowers ... 57–61
Santa Clara County—Report by A. H. Weber, Assistant in Field ... 48–56
Santa Cruz Island, by W. A. Goodyear ... 155–170
Slate quarrying in California ... 282–283
State Mineralogist, introductory to report of ... 15
Trustees, report of ... 7–11
Value of fossils as indications of important mineral products, by Dr. J. G. Cooper ... 284–286
Weber, A. H., Assistant in Field—Report on Santa Clara County ... 48–56
Willey, Harry I.—Report on Geological Survey of California ... 40–45
Yates, Dr. Lorenzo G.—Report on Channel Islands ... 171–188

ERRATA.

Page 41, line 20 from top, for "Lichthoven," read "Richthofen."
Page 44, line 13 from top, strike out all between words "employment" and "Such."
Page 44, line 16 from top, between words "Legislature" and "wise," insert "of 1888."
Page 44, line 16 from top, for "this," read "the."
Page 46, line 30 from top, between "State" and "not," insert "and."
Page 64, line 17 from top, for "chili," read "Chili."
Page 65, line 3 from top, for "sulphide," read "sulphate."
Page 65, line 4 from top, for "sub-ammoniac," read "sal-ammoniac."
Page 65, line 5 from top, for "ammonia," read "ammonium."
Page 66, line 5 from bottom, for "oxidized," read "volatilized."
Page 68, line 5 from bottom, for "turpidity," read "turbidity."
Page 68, line 22 from top, for "hausing," read "housing."
Page 70, line 14 from bottom, for "turpidity," read "turbidity."
Page 76, line 7 from bottom, for "residue," read "residual."
Page 77, line 7 from bottom, for "residue," read "residual."
Page 77, last line, between "as" and "also," insert "are."
Page 77, last line, for "operations, read "manipulations."
Page 94, line 25 from bottom, for "excentric," read "eccentric."
Page 100, line 7 from top, for "excentric," read "eccentric."
Page 112, line 18 from bottom, for "chronite," read "chromite."
Page 144, line 5 from top, for "mine," read "mill."
Page 206, line 3 from top, for "spirifer," read "turritella."
Page 248, line 6 from top, for "intelligent," read "intelligence."
Page 255, line 35 from top, for "Gouach," read "Gouache."
Page 328, line 11 from top, for "this search," read "his search."

To his Excellency R. W. Waterman, *Governor of California:*

Sir: The Trustees of the State Mining Bureau herewith submit their report, in pursuance of the Act of the Legislature entitled "An Act supplementary to an Act entitled 'An Act to provide for the establishment and maintenance of a Mining Bureau,' approved April 16, 1880," approved March 21, 1885.

Respectfully,

J. Z. DAVIS.
W. S. KEYES.
GEO. C. PERKINS.
W. T. GARRATT.
THOS. B. BISHOP.

San Francisco, December 1, 1889.

REPORT OF TRUSTEES OF THE STATE MINING BUREAU.

At the last session of the State Legislature there was appropriated, for the support and maintenance of the State Mining Bureau, the sum of $100,000, to be expended under the direction of the Trustees in conjunction with the State Mineralogist. Of this amount, at least 70 per cent was to be used for "geological work in the field." (See Act approved March 14, 1889.) The Act failed to mention that the appropriation should be paid "from moneys not otherwise appropriated."

In view of this contingency, the State Controller refused to allow the first demand of the Board, therefore it became necessary to apply to the Supreme Court for a writ of mandate, which, after a full hearing, was granted on the twenty-seventh of August last past.

Pending the decision of this matter, of vital importance to the Bureau, the Board deemed it only prudent to exercise rigid economy in their expenditures, and relieved from duty every employé, with three exceptions, who were imperatively needed to look after and preserve from deterioration the very valuable collection of rocks, ores, minerals, shells, fossils, etc., belonging to the State, and exposed for public inspection in the rooms of the Museum. As a consequence, the assistants of the State Mineralogist, who, under ordinary circumstances, would have entered upon their duties in the field as soon as possible after April first, could not be secured and some of them accepted other employment.

As soon, however, as the Supreme Court had favorably answered the petition of the Board of Trustees, all haste was made to vigorously prosecute the work in the field. The State Mineralogist, with his accustomed zeal and energy, selected his assistants and, with the approval of the Board, set them at work on and immediately after September first of the current year, and his report, necessarily brief, owing to the short period when field work was possible before the rainy season, will, we trust, prove acceptable to your Excellency, the Legislature, and the general public.

The Mining Bureau is, beyond question, fulfilling a popular want, and daily growing in public favor. This, we think, is proven by the demand for the published reports of the institution. The sixth annual report of the State Mineralogist consisted of six thousand copies, where, before that time, only one third of this number was printed. In spite, however, of the increase, the edition has long since been exhausted. The seventh annual report appears to have been equally appreciated, as there now remain but few copies for general distribution. In view of these facts, by order of the Governor, an edition of ten thousand copies of the sixth annual report was issued, and of these four fifths have already been distributed, and there are daily requests for additional copies from learned societies and practical workers. Indeed, so favorably received were some of the special articles contained in the sixth annual report, that it was found necessary to order an additional supply printed in pamphlet form.

The Trustees, in a word, congratulate the State Mineralogist that his reports do not flag in interest and are fully appreciated, not only by the learned societies with whom we exchange, but also by the mechanics, miners, and other artisans, for whom, as comrades of "the army of industry," these publications are primarily intended.

During the past year very nearly one thousand specimens of rocks, ores, earths, etc., have been submitted to the Bureau for determination, and the senders have been promptly notified of the results in all cases where it would appear to be a matter of public interest.

The Bureau does not undertake to compete with private enterprise and does not make assays nor analyses for the benefit of private individuals.

THE MUSEUM.

The Museum has, during the past year, been enriched by the addition of over one thousand five hundred specimens, which have been classified and placed on exhibition. Twenty-six flat and three large wall cases have been constructed and filled, and the rooms are fast becoming too crowded for a proper display of our very valuable collections. The assistants in the field have obtained and forwarded many rare and interesting specimens, and the President of the Board, J. Z. Davis, Esq., has placed on exhibition a very complete and instructive suite of fossil and modern shells and a number of unique and very costly bronzes.

VISITORS TO THE MUSEUM.

From October 1, 1888, to October 1, 1889, the Museum of the Bureau was visited by throngs of resident citizens and sojourning strangers, of whom over nineteen thousand signed the register, while an uncounted but very large number failed to signify in this manner their appearance at the rooms.

FACILITIES FOR RECEIVING SPECIMENS.

Wells, Fargo & Co.'s Express continues to forward to the Bureau, free of charge, any package or packages weighing less than twenty pounds, which may be intrusted to their care in any parts of the States and Territories of the Pacific slope.

The Pacific Coast Steamship Co. has, during the past year, similarly favored the Bureau, and the Trustees gladly acknowledge the courtesy of both incorporations.

List of Donors to the Museum from October 1, 1888, to October 1, 1889.

Aaron, C. H.
Abbott, A.
Abrams, J. D.
Adams, H. C.
Adams, W.
Adams & Nichols.
Addis, J. M.
Allen, Chas. R.
American Bridge and Building Company.
Andrews, Col. A.
Armstrong, W. T.
Arnheim, J.
Atkins, R. D.
Attwood, M.
Austin, F. B.

Baranoffsky, General.
Barcroft, Fred.
Barstow, C. B.
Bartlett, A. L.
Barton, H. J.
Beckett, J. F.
Blanc, A.
Blake, Dr. Gorham.
Blake, Prof. Wm. P.
Blanding, Louis.
Billings, Geo. A.
Bingham, C. B.
Böhmer, H. S.
Bonanza Gold Mining Co., Sonora, Tuolumne County.
Boomer, Paul C.
Bowers, Stephen.
Bowers, W. O.
Bowman, C.
Brady, E. O.
Braverman, M.
Brewery Gold Mining Co.
Brian, J. W.
Bronson, Chas.
Brothers, Wm.
Brown, Prof. F. D.
Brown, W. Q.
Brumagim, Miss Blanche.
Burnell, H.

Caldwell, Daniel.
Caldwell, J. M.
Centennial Gold Mining Co.
Chapin, W. C.
Chipman, Justice.
Christiansen, P.
Clark, Ezra.
Clark, N. and son.
Coffin, F. F.
Cole, E. H.
Cowles, W. N.
Cox, Joseph F.
Craib, W.

Crapo, William.
Crossman, J. H.
Curtis, J. M.

Dana, A. W.
Dart & Oliver.
Davis, J. Z.
Day, Mrs. H. H.
Delfs, M. A.
Dickinson, Thos.
Dixon, Miss.
Dolbeer & Hoff.
Donnelly, J. W.
Doyle, R. E.
Duncan, W. E.

Ellsworth, Col. A. M.
Emerson, L. G.

Fawcett, Edgar.
Faxon, J. T.
Fleming, E. C.
Finch, N. S.
Fisher, Dr.
Ford, Edward L.
Foss, J. W.
Frost, L. L.

Garvey, Richard.
Gisborn, M. T.
Goddard, Geo. H.
Gold Run Mining Company
Goodall, Perkins & Co.
Goodyear, W. A.
Graham & Reed.
Greathouse, Hon. C. R.
Green, Jno. C.
Green, J. G.
Greenwell, L. W.
Griffing, Geo.
Grimmer, C. A.
Grover, Mrs.
Groves, G. O.
Gutman, D.

Hadsell, C.
Hague, Capt. C. J.
Hamilton, C. A.
Harkness, Dr. H. W.
Harlow, E. W.
Hanauer Smelting Company.
Harney Peak Tin Mining Co.
Hatch, W. T.
Hearst, Hon. Geo.
Hemsley, J.
Hendrick, Wm.
Henly, Geo. J.
Heslewood, J. A.
Higgins, P. C.
Hill, Benj.
Hoff, J. D.
Hook, B. F.
Howard, Frank.
Howard, General O. O.
Howard, W. C.
Holmes, A. J.
Hosmer, H. L.
Hughes, D. T.
Hutchins, W.

Ingham, A. H.

Jenkins, W. W.
Jenney, Walter P.
Job, J. A.
Johnson, J. F.
Johnston, J. A.
Jones, Thos.
Jory, Jos. H.

Kenyon, E.
Kenyon, T. W.
Keyes, W. S.
Kilpatrick, A. S.
King, L. M.
Knapp, Henry R.
Knox, R. F.
Kruse & Euler.

Laidlaw, C. H.
Lake, H. W.
Lane, Dr. L. C.
Lawrence, W. J.
Lawson, John.
Lavelle, Wm.
Lee, Chas.
Lewis, L. J.
Lintner, Martin.
Little, J. A.
Livermore Stone Company.
Locke, Sam.

Madsen, A.
Maggard, Aitken.
Markson, P.
Marshall, John S.
Maslin, Hon. S. Prentiss.
Mason, Dr. Benj. F.
Maxwell, J. W.
McCaw, Arch'd B.
McCormick, John.
McDonald, Geo.
McDonald, Capt. J. M.
McDonald, James.
McEwen, Wm.
McGregor, A.
McIntyre, A.
McKillican, D. R.
McLeod, R. R.
McMurray, R.
McRacken, W. S.
McRae, Norman.
Metzger, C. L.
Miller, F. A.
Miller, R. W.
Mills, Mrs.
Mineau, John J.
Minnesota Acad'y of Science.
Mitchell, H. K.
Monroe, Donald.
Monteverde, F. E.
Morris, Elias.
Morrow, N. L.
Moses, Otho.
Mosgrove, D. L.

Need, E. C.
Nellis, J. W.
Nelson, Ole.
Newhall, H. G.
Newhouse, O.
Newman, W. L.
Newman & Wing.
Neyman, C. M.
Nichols, Dr. Geo. B.
Nisley, P. W.
North Star Gold Mining Company of Grass Valley.
North Star Gold Mining Company of Sutter Creek.
O'Gorman, J. F.
O'Riley, James.

Pacific Stone Company.
Pahl, Richard.
Paine, J. C.
Parker, James.
Payson, L. M.
Peebles, Ed. L.
Perkins, H. C.
Perry, R. D.
Porter, Dr. Thos.
Prentiss, S. R.
Preston, E. B.
Providence Gold Mining Company.
Purinton, C. P.

Querolo, J.
Quimby, T. J.

Radelfinger, Fred.
Ream, D.
Ream, Dr. R.
Reimers, Gus.
Reilly, Geo. H.
Reynolds, C. C.
Reynolds, R.
Richardson, J. B.
Richardson, Robt.
Rider, P. W.
Roberts, A. E.
Roberts, Wm.
Robinson, J. A.
Robinson, L. L.
Roby, F. M.
Roggenkamp, H.
Roseman, H.
Royal Agricultural and Commercial Soc. of Demerara.

Sacramento Ione Coal Company.
Saling, R.
Sanders, T. B.
San Pedro, M.
Sargent, Hon. B. V.
Schamp, W. H.
Schroeder & Werner.
Scott, James A.
Scott Bar Mining Company.
Seymour, E. C.
Shed, John.
Sime, S. D.
Sinton, R. H.
Silver, Lowry.
Smith, E. Everett.
Smith, O. A.
Smith, W. C.
Soderling, A.
Sonnenfeld, Samuel.
Sprague, Geo. E.
Stanley, J. P.
Stevens, W.
Stone, D. C.
Stone, J. R.
Stow, H. P.
Sweet, S. S.

Talbott, J. F.
Taylor, A. C.
Taylor, J. B.
Taylor, R. B.
Taylor, S. S.
Thompson, Jas. G.

Thwaites, Geo. H.

Vehling, Fred.

Wallace, J. T.
Ward, A. H.
Ward, C. T.
Ward, Jas. B.
Wegner, R.
Weitbrecht, Geo.
Wertheimer, M.
Weyl, J.
Wheeler, John.
White, Miss Dollie.
Whiting, H. A.
Wilbur, O. C.
Wilcomb, C. P.
Wilkins, Jas. H.
Willey, Gen. H. I.
Wolleb, T. G. E.
Woodhull, S. D.
Wooding, J. W.
Woodruff, A.
Woody, Wm.
Wores, Chas. R.

Yates, Dr. Lorenzo G.
Yount, Samuel.

THE LIBRARY.

The Library of the Bureau continues to increase. Over seven hundred books have been added during the past year, making a total of over three thousand four hundred bound volumes, besides a large number of valuable pamphlets.

Most of this gratifying increase has arisen from our system of exchange with foreign and domestic scientific bodies and institutes, supplemented by the publications of the General Government and of the several States of the Union. Only thirty-seven books have been acquired by purchase.

The space devoted to the Library is altogether inadequate, and it has been found necessary to store many volumes, which, owing to lack of case accommodation, we have been unable to properly expose. The rooms are constantly crowded with students and specialists to consult our works of reference, which we endeavor to keep abreast of modern research and investigation. Indeed, so pressed is the Bureau for room, that neither the Board of Trustees nor the State Mineralogist has been able to set apart a room for a place of meeting, nor one for our office.

A catalogue of the Library is in process of compilation. This will lighten the labors of the Librarian and materially aid the seekers after knowledge.

We have completed, as far as possible, the full series of Government imprints on subjects kindred to the aim and objects of our institution, as well as those published by the several State Geological Surveys.

The following papers continue to be sent to the State Mining Bureau free, and we appreciate the courtesy thus extended:

Amador Dispatch, Amador, California.
Arizona Gazette, Phœnix, Arizona.
Calaveras Citizen, San Andreas, California.
Crescent City News, Crescent City, California.
Daily Union, Grass Valley, California.
Exchange and Mart, Boston, Massachusetts.
Financial Mining Record, New York, New York.
Honduras Progress, Tegucigalpa, Honduras.
Inyo Independent, Independence, California.
Lower Californian, Enseñada, Lower California.
Middletown Independent, Middletown, California.
Miner and Artisan, Los Angeles, California.
Mining Industry, Denver, Colorado.
Mining Review, San Francisco, California.
Mountain Democrat, Placerville, California.
Mountain Messenger, Downieville, California.
Oakland Daily Tribune, Oakland, California.
Placer Argus, Auburn, California.
San Leandro Reporter, San Leandro, California.
Santa Ynez Argus, Santa Ynez, California.
Ventura Vidette, Ventura, California.
Visalia Delta, Visalia, California.
Weekly Star, San Francisco, California.
West American Scientist, San Diego, California.

ACCOUNTS FROM OCTOBER 1, 1888, TO OCTOBER 1, 1889.

Receipts.		
Balance on hand October 1, 1888	$19,647 21	
Less difference of $444 20 between amounts reported and collected by License Department up to and including September 30, 1889	444 20	
		$19,203 01
Paid into Mining Bureau Fund		6,845 05
Appropriation		50,000 00
Disbursements.		$76,048 06
Salary of State Mineralogist	$3,000 00	
Rent of premises	3,000 00	
Salaries of Bureau employés	6,360 00	
Salaries of geological assistants	6,624 00	
Museum and minerals	1,267 40	
Library	620 36	
Postage	762 30	
Traveling expenses	4,731 24	
Laboratory	252 52	
Clerical assistance	607 00	
Freight and express charges	267 05	
Sundries, Bureau	599 12	
Sundries, geological	83 45	
		28,174 44
Balance on hand October 1, 1889		$47,873 62

To his Excellency R. W. WATERMAN, *Governor of the State of California:*

SIR: In accordance with the provisions of an Act of the Legislature entitled "An Act to provide for the establishment and maintenance of a Mining Bureau," approved April 16, 1880, I herewith transmit my report, regretting that causes heretofore mentioned in the report of the Trustees have so greatly retarded my work and abbreviated this report.

Very respectfully,

WM. IRELAN, JR.,
State Mineralogist.

SAN FRANCISCO, December 1, 1889.

REPORT OF THE STATE MINERALOGIST.

The clear and comprehensive report submitted by the Trustees of the State Mining Bureau to his Excellency Robert Whitney Waterman, Governor of the State of California, and published elsewhere in this volume, will make the reader fully acquainted with the reasons for delay in issuing the ninth annual report, and, also, why while the document nominally covers the space of twelve months that scarcely more than two have been devoted to active operation in the field. The short period thus left the State Mineralogist in which to obtain necessary information, has, however, been utilized to the best advantage.

Outside assistants, of known ability, well equipped, were dispatched as promptly as possible, when matters were arranged at Sacramento, to the several important fields of research and observation throughout the State. As will be found by the returns printed in the present volume, they have addressed themselves to duty with alacrity and intelligence, and the amount of original and fresh information the field assistants have gathered—unexpected, it may be added, considering the brief time allowed for work—is herewith given to the public, in full confidence that it will be found both interesting and beneficial to all parties concerned.

In this connection it will be as well to state that the Trustees, desiring to make the Bureau the highest possible source of intelligence on all subjects of geological and mineralogical interest, have encouraged the State Mineralogist in his oft expressed purpose to commence the preparation of a geological map of the State, the object and character of which are fully explained in the paper printed elsewhere by General H. I. Willey. When completed this map will be of much service, not only to the people of the State, but to a large number of scientists and others throughout the civilized world, who regard our varied and inexhaustible resources as phenomenal. It will be readily perceived the work must occupy considerable time, but its commencement at once by competent executants, will, to all thoughtful persons interested in the prosperity of California, commend itself as a proper move to make.

In concluding his prefatory remarks, the State Mineralogist deems it his duty to acknowledge the many obligations he is under to the present Board of Trustees of the State Mining Bureau, J. Z. Davis, Esq., President; Winfield Scott Keyes, Esq., Vice-President; Hon. Geo. C. Perkins, William T. Garratt, and Thomas B. Bishop, Esquires, for their earnest and enlightened coöperation.

Mr. J. Z. Davis' trusteeship is as marked with liberality as ever, and during the past year his donations have been both numerous and costly.

To Mr. Sol. Heydenfeldt, Jr. (resigned), the Bureau is indebted for his unqualified assistance and valued advice.

He is also indebted to his Excellency Governor Waterman, for many important hints and suggestions bearing upon the best interests of the State. The fact that his Excellency is practically as well as theoretically thoroughly versed in the business of mining, makes his advice all the more valuable.

The following list comprises the names of employés:

W. A. Goodyear, Chief Geologist.
E. B. Preston, Assistant Geologist.
H. I. Willey, Engineer.
John Hays Hammond, E.M., special article.
Ross E. Browne, E.M., special article.
Russel L. Dunn, E.M., special article.
W. D. Johnston, M.D., Chief Chemist.
C. A. Ogden, Ph.D., Assistant Chemist.
H. S. Durden, Curator.
Carl Schneider, Mineralogist.
J. G. Cooper, M.D., special article.
Henry De Groot, M.D., Assistant in the Field.
Dr. Stephen Bowers, special article.
James H. Crossman, Assistant in the Field.
A. H. Weber, Assistant in the Field.
S. Gumbinner, special article.
Dr. Lorenzo G. Yates, special article.
Miss Morgie Maynard, Librarian.

The State Mineralogist regrets that the limited period afforded for field operations, has necessarily prevented him from furnishing the usual review of the various mining industries of the State, for the current year.

In the early days, when mining occupied the foremost place among the then nascent industries of California, it was the practice of the principal journals of the State to devote columns to a review of the conditions, progress, and prospects of the mining business. At the close of every year elaborate articles were published on the subject; in some cases, quarterly reviews were printed. Gradually, as the production of our mines lessened, and other material interests pushed themselves into notice, these mining reviews were curtailed until they shrank to mere items, or were discontinued altogether. The Mining Bureau of the State is now left, therefore, as the only center and the best source of this desirable information for the public. It is for this reason the State Mineralogist devotes his energies to collecting facts relating to all branches of the business, sifting, analyzing, and arranging them with a view to their entire trustworthiness. It is only in this way that the Bureau can be rendered deserving of public confidence and support.

Not until last year was the State Mineralogist able to make anything like a complete review of our mines and mining operations and the constantly occurring improvements in this industry.

The volume issued for the year 1888 deals with every mining county in the State, and contains much detailed information concerning the geology, character of the ore deposits, and the vein system of our various gold-bearing belts. It is also affluent in facts regarding the mechanical methods, the processes employed in the reduction of various kinds of ores, and in the extraction of metals.

Every prominent mining property in the State in operation at the time, producing or being actively developed, is noticed—many with much particularity. The number, weight, and drop of the stamps; cost of supplies, labor, and material; the ore crushers and feeders, concentrators and amalgamators, roasters and smelters; in short, every method, appliance, process, and device brought into mining use thus far was described. In order to facilitate reference a great deal of the information is tabulated. It is not necessary, of course, to reproduce much of this data.

The "review" of 1888 will serve the miner and others interested as a book of reference for some time to come; and thus, while room will be given to information concerning new developments and processes, ampler space can be afforded in subsequent volumes to other matters affecting directly, or germane to the vast and important mining industry of our State. And this leads to the consideration of how much the marvelous prosperity of this entire country is due to mining. Every State in the Union owes this industry something; the mid-continental regions almost their very existence. Even California, with all her wealth of soil and climate, is largely indebted to the product of her mines for her present thrift. As for the most of her neighbors, they would, but for their mineral resources, have remained a vast wilderness to this day.

The value of the gold, silver, copper, and lead turned out in the Pacific States and Territories amounted to $120,000,000 last year; the total value of all the mineral products of the country having reached the enormous sum of $538,000,000. This exceeded the output of the year before by $70,000,000, and was greater by $100,000 than the entire product of the United Kingdom, and greater than that of all Continental Europe put together.

Nor is the prevailing impression that mining investments are unprofitable, as compared with most others, at all well founded. On the contrary, statistics show the reverse to be true, mining having disbursed more money in dividends during the past thirty years than any other branch of business. Henry B. Clifford, in the New York "Tribune," makes the statement that twelve of our leading smelting companies show the largest profits of any business in America.

Of the $110,000,000 produced by the mines in the West last year, 10 per cent, it is estimated, went to pay railroad transportation, 37 per cent to mine owners, and 15 per cent to smelting works, the remaining 38 per cent having been paid out for labor. It would be difficult to find any other large industry that returned during the year 37 per cent to the investors.

Speaking of mining, we do not include in the business gambling in mining shares, any more than does the writer on wheat growing take into his calculations the transactions of speculators in that cereal.

But aside from these large profits to the smelters and investors, these revenues to railroads, and wages paid workmen, the aid mining extends to the other industries of the country must be considered, and in this respect it is hardly of secondary importance. It is a universal helper.

There are at present about thirty thousand men engaged in the various branches of mining in California.

As now employed these miners are competitors to only a limited extent with the laborers engaged in other pursuits. They are not contending with the mechanics, the farm or factory hands, or the great unskilled army of toilers, for a living. They are not raising and putting on the markets the products of the farmer, the fruit grower, or other land tiller, nor are they waging a war on any other class of workers or producers. On the contrary, they are creating a demand for the things these people fabricate and grow—they are users and consumers, not makers of what they have to sell. Take these thirty thousand men out of the mines and distribute them among these other industries, and what would be the result? The mechanic shops, the factories, and the foundries would have more applicants for work with less work to do, and so of every other mechanical pursuit in the State.

The cultivators of the land, the fruit growers, and the stock raisers would, in like manner, have their productive forces increased, their markets being at the same time in like ratio diminished. What a hardship it would be to our mechanics, laborers, and artisans were all this host of miners recalled from the mountains to divide themselves up into squads of several thousands each, and then invade our other already overburdened industries, seeking employment. What a reduction of wages, stagnation of business, and general consternation and distress would such a movement at once precipitate!

Then, too, with mining extinguished, we would be obliged to import a great many articles which we at present produce ourselves, and thus much money would go abroad which is now retained in the country. As has well been said, any attack on legitimate mining is a two-edged sword—it cuts both ways, wounding those against whom its blows are directed and those who wield it.

But while the mining industry is so largely helpful to California, it is also vital to most of her neighbors. Without this resource few of them could ever have attained to the dignity of Statehood, or even been able to maintain a Territorial organization. Take away the Comstock ore belt with its three thousand miners, its great plant, and other costly improvements, and what would there be left of western Nevada? Nor, without its mineral deposits, would more than a few fertile valleys in the rest of that State ever have been wrested from the occupancy of the Pah-Utes and Shoshones. But that the Comstock created a demand for forest products there would have been no great wood and lumber camps on the summit and eastern slope of the Sierras, the most of them over the line in California. But for the Comstock, instead of the great sawmills, long-extended tramways and wood flumes, there would have stood on these mountains only the primitive forests, scarcely invaded by the enterprise of man.

As a civilizer and populator of the imperial West, mining has not been awarded its full share of merit, if, indeed, it has met with proper appreciation at the hands of our countrymen, to say nothing of the outside world. This great West, which in its maternity of States bears twins, and even triplets, owes its wonderful fecundity mainly to its mines.

The impression widely obtains that the gold mines in California have been depleted below the point of profitable production. Many otherwise well informed persons entertain this idea. Nothing can be more erroneous. As already remarked, the gold taken out has exhausted but little of our auriferous wealth, nor has the annual production heretofore much exceeded what we may reasonably hope to reach and maintain in the future.

Again, it is a mistake to suppose, as many do, that the earnings of the pioneer miners were greatly in excess of those at the present day. They were, to be sure, somewhat larger, but not in the proportion popularly believed.

During the era of the largest gold production in this State—say from 1850 to 1855, inclusive—the annual output of gold averaged only about $55,000,000. As the mining population numbered, meantime, about one hundred and fifty thousand, their individual earnings averaged barely $366 per year, not much more than the smaller population now engaged in the mines are able to earn, working by no means so many days in the year as did their predecessors. Those who work for wages do nearly as well now as they ever did, all things considered. But it now requires a larger amount of both skill and capital to accomplish much in our mines than were needed in the early days—a condition of things that puts the mere wage-earner and worker at a disadvantage.

With the above two factors supplied, the opportunities for making money in both the gold and silver mines of California are really better now than they ever were before. This the history of the business during the past decade fully demonstrates. It has, during that period, been growing steadily, and even rapidly, in all the elements of desirable investment—profit, efficiency, economy, and safety—a condition that cannot fail to draw to it capital and insure the countenance of both legislators and the people. Purged of the grosser abuses that so long militated against it, its mistake largely corrected and so many other gains made, there can be no doubt but that mining will, from this time on, make rapid advances in this State. It would take but little time and energy now to double the present number of our miners, and reach a corresponding increment in our output of gold and silver. Thirty thousand additional men in the field, followed by an annual production of thirty-five or forty millions of the precious metals, would be a grand thing for California. How it would vitalize trade, encourage enterprise, and impart a healthful impetus to every interest and industry in the State! The price of labor would be advanced, idle men and idle capital would be employed; there would be improvement everywhere and in everything; in the value of agricultural lands and their products, in city property, and even in the value of money itself.

As regards the extent of our mining field, it is simply illimitable. A hundred millions of additional capital might as well be invested there as not, nor would a hundred thousand men crowd it any more than sixty thousand. Of the mineral deposits that actually exist in California, not a tithe probably has yet been discovered, nor has a much larger proportion of those already discovered been developed to a productive condition. We have made a good beginning—hardly more.

With this much premised, we proceed in succeeding pages to briefly review mining operations in California during the past year.

CALIFORNIA'S VARIETY AND DISTRIBUTION OF MINERAL WEALTH.

Remarking on the various branches of mining actively pursued in California, it may be observed that with the most of them the past has been a year of more than average prosperity. Mining in this State is not now confined, as formerly, to the production of the precious metals. While gold mining continues with us the leading branch of the business, several of the inferior metals, as well as many of the useful minerals, are now produced here in considerable quantities. Of the latter there remains still a number with which little or nothing has been yet done, though we have them of good quality and in the greatest abundance.

Besides her gold fields, the most extensive and prolific of any in the world, and silver-bearing lodes in countless numbers, California possesses the more common metals and minerals in great variety, as will be seen by referring to previous reports of the State Mineralogist. This State is amply supplied with deposits of iron, tin, lead, copper, and quicksilver; borax, salt, and soda; petroleum, natural gas, and asphaltum; gypsum, steatite, graphite, manganese, and chromium; and with coal, nickel, antimony, asbestos, cements, ochre, sulphur, and magnesia to a more limited extent; the plastic clays, infusorial earth, lime, and building stones, including the fissile slates, abounding in many parts of the State.

There is scarcely a county in California but possesses valuable mineral deposits of one kind or another, the wide distribution of these products being something remarkable. Of the fifty-three counties in the State fourteen make a notable production of gold and twelve of both gold and silver, there being a number of counties in which these metals in smaller quantities are turned out every year. Five counties produce more or less quicksilver; two, borax; three, salt; four, asphaltum; two, petroleum; three, copper, etc.

That these common minerals have not been more largely utilized, has been due mainly to the lack of a market, the domestic consumption of the most of them having heretofore been exceedingly limited. Being for the most part cheap commodities, but few of them would bear the cost of transportation to distant points; hence, the limited extent to which these products have been turned to practical account. With available markets, such as may soon be counted on, all this will be changed.

At the rate California is being populated, it will not be long till the number of her inhabitants will be doubled, causing a corresponding increase in the home demand for these articles. Meantime, freights will be likely to undergo such reduction as to make possible their more free shipment abroad; and thus will be brought about, in the not distant future, the establishment of many additional industries and the opening up of new sources of wealth in California.

They who suppose our energies are to be devoted wholly, or even mainly, to agricultural and manufacturing pursuits are not well advised as to either the extent or the diversified character of this branch of our natural resources, nor would they seem to quite comprehend how largely some of these low-priced metals and minerals are likely yet to supersede the use of wood as a structural material. Already our houses and factories, ships and railroads, aqueducts and street pavements, not to mention innumerable other structures, implements, and mechanisms, are composed mainly of iron, lead, copper, asphaltum, the clays, the marbles, or other building stones; wood as a fuel having already been, in good measure and in many localities, wholly displaced by coal, natural gas, and petroleum.

MINING BARELY BEGUN IN CALIFORNIA.

Were California even poor in the precious metals she would yet become a great mining State. With such wealth as this she is, in this respect, destined to be a very important factor in the financial affairs of the world.

Gold mining is with us in an embryotic state. It has not yet reached even the stage of sturdy infancy. Our true golden era rests in the future, not in the past. Our El Dorado has not yet been revealed to us. It lies buried deep in the bowels of the earth.

The placer deposits that have made for us such a name, and given to mining such impetus and eclat, were but driblets which nature, having released from their matrices, brought within our easy reach as a means of encouraging us to further efforts, and leading us on to that greater and more enduring wealth stored away in the rocky ribs of the mountains.

What is here claimed for the future of mining in California is strongly foreshadowed by what has already taken place. For several years past our annual output of bullion has more than held its sum, and but for the suppression of hydraulic mining, formerly a prolific source of production, would have shown a marked increase. That gravel washing by this method will be resumed, at least in part, we have reason to hope. It would hardly be creditable to our engineering skill should we fail to devise means and methods whereby this class of debris could be so disposed of that hydraulic operations might be largely carried on without serious detriment to other interests. Could this very desirable end be reached, the gold product of the State would at once be advanced by several millions annually.

But whether this shall occur or not, that our output of bullion is going to show rapid increment is hereafter well assured.

DEBASING THE BULLION.

In this connection it should be observed that as the bullion made in California contains but a small percentage of lead and copper, the State is placed at a disadvantage when compared with certain of her neighbors, which produce these metals in large quantity, the whole being credited to them as bullion. Thus, of the large amount of bullion, $33,000,000, set down last year to Montana, more than half consisted of lead and copper; of gold and silver she turned out but little more than California, her gold product being barely one third of ours. The same remark applies, though in less degree, to Colorado, Utah, Idaho, New Mexico, and Arizona. The bullion of Oregon, Dakota, and Washington consists almost wholly of gold; that of Nevada being composed of about 40 per cent gold and 60 per cent silver.

Apart from the injustice done California, there are, it seems to us, good reasons why this custom of classifying these base metals as bullion should be abandoned. In the first place, it is a perversion of language to so classify them, inasmuch as bullion consists of uncoined gold and silver and not of lead or copper pigs. Then, again, on the question of coinage and currency it tends to mislead. Our legislators, statisticians, and economists should not be led to suppose that these Pacific States and Territories produced last year bullion to the amount of $115,000,000, when their actual production of the precious metals was less than $90,000,000. At a time when commerce and the great industrial interests of the world are increasing at a much more rapid rate than the output of the precious metals, no intentional exaggeration of the latter should be indulged in. If this reputed output of bullion is short by $25,000,000 or more per annum, the parties who have to deal with these monetary matters ought to know it, so that they may govern their actions accordingly. It is really the case that there has for these countries been returned an aggregate of some $100,000,000 or more as bullion, that simply consisted of copper and lead. This practice, so misleading, came in with the induction of silver mining, these metals coming to be accounted bullion through their connection with silver.

In considering the bullion made in this State for the past eight or ten years, it must be borne in mind that comparatively little money has, during that period, been invested in our mines, preference having been given by capitalists to real estate, timber, railroads, and various other lines of investment. But there are, in this respect, indications of a change. With the many improvements effected it is found that mining is becoming a tolerably safe as well as a profitable industry in California. Some reverses have come, as they will come in every pursuit, yet scarcely any notable losses have here occurred in the business of late years; none, in fact, except by reason of management clearly defective, if not criminally faulty, or through investments of a purely speculative kind. But with the latter, mining has had no more to do than had the wheat growers of the State with the effort made here a few years since to control the prices of that cereal, or copper mining with the more recent operations of the French syndicate in their attempt to corner the copper markets of the world—all of which combinations resulted so disastrously to their promoters, and, in some instances, also to innocent outsiders.

As regards dealings in mining shares, these, with us, have dwindled to such small proportions that they now cause very little harm; none whatever to the business of legitimate mining. They are confined mostly to that class who are not to be restrained from hazarding some of their means in this or other forms of gambling.

NUMBER OF MEN ENGAGED IN MINING.

There has, among writers on the subject, ever existed a wide difference of opinion as to the number of men engaged in the business of mining in California, and, for that matter, in other of the Pacific States and Territories as well. H. C. Burchard, Director of the Mint, in his report for 1882, estimated the number throughout our entire mining region as follows:

Arizona	4,678
California	37,147
Colorado	28,970
Dakota	3,570
Idaho	4,708
Montana	4,813
Nevada	6,674
New Mexico	1,496
Oregon	3,696
Wyoming	328
Utah	2,592
Total	98,672

This, though much larger than the number fixed on by some, was at the time probably very nearly correct, the total in all these States and Territories, except California and Nevada, having been somewhat, and in most cases, largely increased since, reaching now one hundred and forty thousand, at least. By this is meant persons engaged directly and indirectly in mining for gold, silver, lead, and copper, there being a good many in California, with a few also in some of the other States and Territories named, engaged in various other branches of mining.

Assuming that the total bullion product of these several States and Territories amounted this year to $120,000,000, the individual earnings of this army of men would have been $857 each.

From official returns received by the Chief of the Bureau of Statistics of Pennsylvania for 1888, it appears that the wages paid twenty thousand miners, employed at one hundred and thirty collieries, during that year were as follows—the earnings of the best paid men amounted to over $700, while the poorest paid reached barely $200, the average in the anthracite and bituminous regions jointly having been about $500. The most of these men work steadily the year through.

According to official accounts the average earnings of the miners in Australia are considerably less than in California.

In apportioning the mining population among the different States and Territories, they may be assigned as follows:

Arizona	5,000
California	37,000
Colorado	35,000
Dakota	5,000
Montana	25,000
Idaho	15,000
Nevada	6,000
New Mexico	6,000
Oregon	5,000
Wyoming	1,000
Utah	6,000
Total	146,000

In the absence of any official count, there can only be claimed for these figures an approximate correctness.

It is more difficult to arrive at accuracy on this point in California than in our other mining States and Territories, owing to the much larger number of self-employers we have here, the many different kinds of mining in which they are engaged, and the manner in which they are scattered over a great extent of territory. In these other countries mining operations are carried on more by large companies, the number of whose employés can easily and definitely be ascertained.

Where men are employed by scores, hundreds, and even thousands, as on the Comstock range and in the big mines of Utah, Colorado, and Montana, it is much less troublesome to take their census than where a like number is scattered along the "dead" and the "'live" rivers, the gulches and ravines, or throughout the hydraulic, drift, and quartz mines of California. Dispersed over such wide area, and hid away in the deep gorges and cañons, or toiling in dark pits and tunnels, a good many of these miners would be missed were even a careful enumeration of them undertaken.

THE MONGOLIAN ELEMENT.

Of the entire number of California miners some ten or twelve thousand consist of Chinamen, about one third of whom are employed by the whites on wages, the balance working on their own account or for companies composed of their own countrymen.

Very few of this race engage in vein mining on their own account, nor are more than a few of them so employed by the whites, as they have a great aversion to deep underground workings.

They confine themselves mainly to the various branches of placer mining, such as working over the partially exhausted or wholly abandoned bars and gulches, reworking tailings, and in river-bed operations, the former effected by hand sluicing, the rocker also being sometimes employed, and the latter mainly by means of wing-damming.

The Chinese engage in but little drift mining, never in a large way, though some of them are employed by the white drifters, and also a few about the quartz mills.

Latterly a number of these people have betaken themselves to hydraulic mining, buying or leasing claims that have been enjoined from running. This they have done in the hope of being able to evade the mandates of the Courts, as for a time they succeeded in doing.

Recently, however, these Mongolians have about given up trying to nullify the decrees of the Courts, means having been found for defeating their efforts to that end. In the northern counties the Chinese still carry on hydraulic washing in a few places. In some cases they own the ground, though oftener it is owned by the whites, being worked under lease or on shares. The enactment of the "Exclusion Law" has tended to draw this class of foreigners away from the mineral districts, the increased demand for their services elsewhere insuring the most of them better wages than they can earn in the mines.

THE CALIFORNIA MINER.

In California the miners, more especially those engaged in placer operations, not only are self-employers to a much greater extent than is the case elsewhere, but their labors are here largely intermittent. Very few of them, except those engaged in vein or drift mining, work steadily throughout the year. The river-bed miner can prosecute his labors only in the dry season when the streams are low; other classes work to better advantage in the wet season, when water is plentiful. Only then can the so called "dry diggings" be worked or ground sluicing be carried on. Much of the hydraulic washing is also confined to this season.

Owing to this condition of things, most of our placer miners devote a portion of their time to other pursuits, such as farming, fruit and stock raising, lumbering, etc. They are apt to be land owners in a small way, nearly all of them possessing an orchard and a garden, with a few acres for grain growing and pasturage. The major portion of the gold fields are admirably adapted for grape and fruit culture.

The wages paid underground miners in this State, both vein and drift, are almost uniformly $3 per day. Millmen and other above ground hands receive from $2 50 to $2 75 per day. Chinamen, where employed, are paid about one half these rates. This is without board and lodging; when these are included the miner is charged for them at the rate of about $6 per week.

If the average earnings of the miners who work their own claims fall below the above rates, it is to be considered how much of their time is given up to other pursuits, which, besides contributing largely towards their livelihood, insure them always comfortable homes. In no other part of the world does the miner live so well nor is he so independent as in California. In comparing the annual bullion product of this with that of other countries, the above consideration should also be given due weight.

MORE COMMON MINERALS AND METALS.

Besides our output of bullion, we produce here of the economic minerals and metals values to the amount of several millions annually; far more than is produced by any one of our neighbors or perhaps by all of them put together.

These several industries, omitting the less important, give employment to some four thousand men, distributed about as follows: quicksilver, one thousand; borax, three hundred; salt, four hundred; petroleum and natural gas, asphaltum, three hundred; coal, two hundred and fifty; chromium and antimony, each fifty; slate, marble, and other stone quarries, five hundred; lime, gypsum, and the plastic clays, soda, tin, manganese, etc., one thousand.

QUARTZ MINING,

As for a long time before, continues the leading branch of the business in California. More than two thirds of the gold produced in the State, amounting now to about fourteen millions annually, being derived from this source. While the year under review has been with this class of miners a fairly good one, many of the quartz mills dependent upon water for their motive power were obliged to shut down, owing to the failure of their supply fully a month earlier than usual, causing a corresponding curtailment of bullion.

NUMBER OF QUARTZ MILLS, STAMPS, DROPS, DUTY, ETC.

We have now running in California about three thousand stamps, or their equivalent in crushing power, the number of quartz mills in operation amounting to about two hundred. These mills carry from two or three, though but few of them have less than five stamps, up to sixty each, the average of the whole being fifteen. In addition to these quartz mills, there are twenty cement mills, carrying an aggregate of one hundred stamps, their work being to crush the cement or indurated gravel taken from drift mines. In some thirty-five or forty of these quartz mills the ore is pulverized by devices other than stamps, such as the National rocker, the Huntington, Kendall, Low, Tustin, or Dodge crusher, these several machines being included according to their capacity in the foregoing enumeration of stamps.

From this list of quartz mills there have been omitted a number that may be considered useless, being worn out, or for other reasons rendered practically valueless. On the other hand, several mills in course of construction have been included therein, the work on them being so far advanced that there was reason to expect it would be completed before this report is published. For various reasons one fourth of these mills are not running; another fourth remain idle about one third of the time.

There are perhaps one hundred arrastras running in different parts of the State, some of them by water, the greater number, however, by horse or mule power. The latter crush an average of one ton, and the former two to three tons per day. These machines are employed where there is only a small amount of ore to be crushed, and which must necessarily be of good grade to justify its being worked by this slow method. The arrastra process is a favorite one with the Mexicans, in whose country it is largely adopted in both gold and silver mining.

Of our California quartz mills, about 60 per cent are run exclusively by water, 30 per cent wholly by steam, and 10 per cent by both water and steam, the latter being used when the water fails, as frequently happens toward the end of the dry season.

Attached to a few of the larger mills are chlorination works for treating the sulphurets saved by concentration, now practiced where the ore carries any considerable percentage of auriferous sulphurets, as most of the California gold-bearing quartz do.

The stamps in use with us range in weight from four hundred to one thousand pounds each. The average is about eight hundred pounds, or a little less. In former years they were much lighter than now, the tendency having been steadily towards increased weight. In only a few instances, however, have stamps been used weighing as much as one thousand pounds each. There prevails among our millmen a disposition to find something that will do not only cheaper but better work than the stamps, and many experiments with the various other machines mentioned are being made to that end. That either these or other more highly perfected devices will succeed in largely if not wholly supplanting the stamp, is not improbable. The latter has, however, succeeded in keeping its place in most of the larger mills.

We lift our stamps an averge of seven inches, and drop them from eighty-five to ninety-five times per minute; averaging ninety. Their duty amounts with us a little over two tons per day of twenty-four hours.

COST OF MINING AND MILLING ORE—VALUE AND PERCENTAGE OF SULPHURETS, ETC.

As in every mining country, the cost of ore extraction and reduction varies over a wide range in California, there being mines in this State where the cost of both operations is reduced to less than one dollar. These are, however, exceptional cases, nor are they at all numerous, the cost of mining varying here from 40 cents to $3 per ton, and the cost of milling from 39 cents to $2 per ton, the mean cost of the former being about $2, and the latter about $1 per ton. The figures here given refer to our ordinary gold-bearing quartz. There is a class of this ore so debased that the cost of its reduction is much greater than the rates above given. The expense of reducing

OUR ARGENTIFEROUS ORES

Is also greatly in excess of these rates, some of these ores requiring to be treated by roasting or smelting, though generally susceptible of reduction by simple mill or pan process.

Exclusive of the big establishments, such as the Selby and Melrose Works, designed to buy ores and to do custom work, there are not more than a dozen smelters in the State, the most of these being located in Inyo County, only a small portion of the whole being now in operation. The silver stamp mills are included in the list of quartz mills.

HYDRAULIC MINING.

Although washing by this method has been enjoined in the central mining counties, formerly the field of its largest operations, it is, as heretofore stated, still carried on in the northwestern part of the State, chiefly in Del Norte, Trinity, Humboldt, and Siskiyou Counties. In that region there exists no objection to its being prosecuted, while the conditions for doing so are exceptionally good. Owing to scarcity of water, this class of miners harvested but a scanty gold crop last year. Their compensation came, however, later on. The early advent and great abundance of the fall rains enabled them to begin piping more than a month earlier than usual, while the heavy stock of snow on the mountains insured them an ample water supply far into the next dry season.

All included, there are in this group of counties not less than fifty hydraulic claims being operated at the present time, the most of them, however, only for a portion of the year, and in a small way. They nearly all make liberal returns for the labor employed, and the amount of money expended in fitting them up; the latter is not generally large, as lumber is cheap, and no costly bedrock tunnels are ever required, while comparatively short ditches suffice to introduce water on the ground to be washed. The auriferous gravel banks throughout this region are generally large, the material being at the same time of good grade, and free from pipe-clay and other barren matter. There is everywhere fall enough to prevent any troublesome accumulation of tailings below the washing pits, and there being no farming lands along the outletting streams liable to be injured by the debris from the mines, there is apparently no reason why hydraulic operations may not be carried on here for an indefinite period, and with large profits.

BOOMING.

It was in this section of country that the style of hydraulic mining known as "booming" was first introduced, and has since been most largely in use. It is practiced only along the gulches. These affording but little water, it became necessary that the limited supply be reservoired and properly distributed in order to make it effective in this method of gravel washing. The object is attained by retaining the water in dams and then releasing it suddenly, with a rush or boom. Near the bottom of the dam built for this purpose is left an aperture so large that when opened the water escapes rapidly. Placed on the top of the structure is a small race, through which the water flows when the dam is full, and is discharged into a large wooden box suspended from the end of the sweep, turning on a pivot, and the upper end of which extends to and over the top of the dam. Attached to this end of the sweep is a strip of heavy canvas, which, dropping in a fold over the aperture below, keeps it tightly closed when the dam is full.

When this stage has been reached the water flowing through the race into the wooden box mentioned soon fills it, causing this end of the sweep to sink and the other end to rise, carrying with it the strip of canvas and uncovering the large aperture below, allowing the water to rush out.

Meantime, the wooden box, having emptied itself through numerous small holes made for the purpose, this end of the sweep, relieved of its weight, rises, and the other end drops. The canvas falls over the outletting aperture, closing it as before. Then the dam fills again to the brim, and the operation as above is repeated. This plan for handling water is wholly automatic. It takes care of itself, and goes on day and night, without any attention on the part of the miner, doing its work as long as the water lasts. This is one of those ingenious contrivances for which the California miners have ever been noted. Since its introduction in the northwestern part of the State, it has been brought into use in many other places, some of which have presumed to claim its paternity, a distinction that unquestionably belongs to this State, where this device was originally known as the "Self-Shooter." While to us belongs the credit of this invention, to others belongs the credit of having substituted for the above name the more appropriate one by which it is now known.

DRIFT OPERATIONS.

After the elaborate and exhaustive article on drift mining, published in the last annual report of the State Mineralogist, it would be superfluous to enter here upon any extended description of the business. Confining ourselves, then, to remarking on the practical operations of the part of the year, it may be observed that they have everywhere been prosecuted with more than ordinary diligence, the developed claims having been worked successfully and some new ground opened up.

The Forest Hill Divide, Placer County, the Magalia District, in Butte County, and the vicinity of Forest City, in Sierra County, continue the most active and largely productive drift localities. A good deal is also being done in this line of mining along the Liberty Hill Ridge, about Nevada City, near Gibsonville, and at other points in western Sierra. Some very heavy operations of this kind have recently been set on foot in the latter locality.

Since the suppression of hydraulic washing in the central mining counties of the State, a number of claims before operated by that process have been worked by drifting, and, in most cases, with satisfactory results. In a few instances, however, these attempts proved so disappointing that they have been abandoned.

No very heavy drift operations are carried on in the extreme northern part of the State, nor in any of the counties south of Tuolumne, for the reason that in neither do the rich pliocene deposits occur. In the tier of counties north of Plumas and Butte, drift mining is prosecuted at a great many different points, but mostly in a limited way and along the banks of present streams or in the buried river channels of a comparatively recent date. In the regions mentioned, the claims worked in this manner are so limited in extent and their product so unimportant that they scarcely require to be individually mentioned. The working force employed is invariably small, rarely ever exceeding ten or fifteen hands, and usually about half that number.

Coming south into Butte and Plumas Counties we enter a very extensive and productive field of drift mining. The "dead rivers" here appear in great strength. The Spring Valley Company at Cherokee, Butte County, having worked their ground for many years with notable success by the hydraulic process, concluded during the past autumn to abandon that plan and adopt the drift method. The increasing depth of the superincumbent volcanic matter is the cause of this change. Surveys for the new tunnel have been completed and an estimate of the expenditure required for effecting the contemplated change also made. The expense is much less than was at first anticipated. This mine has for the past twenty-five years employed an average of two hundred and fifty men; its output of gold amounted, meantime, to fully $10,000,000. To make this production only about four thousand eight hundred linear feet of the channel included within the company's ground have been exhausted. Over four thousand feet still remain, but this being of extra large dimensions—eight hundred feet wide and nine feet thick—it is believed the remaining section, worked by the more economic drift method, will yield a total of $15,000,000. As the company own over two thousand inches of water and only about three hundred inches are required for drifting, they will have a large surplus to be sold for irrigation purposes. The principal drift claims worked last year in this county were the Magalia, Lucretia, Bay State, Oro Fino, Indian Springs, and Eureka, several of lesser importance having been operated in the vicinity of Little and Big Butte Creeks.

The value of the gravel extracted in Butte ranges from $1 to $5 per carload; mean value, about $2. In thickness the stratum removed ranges from two and one half to four feet, and in width from twenty to seventy-five feet—that in the Cherokee ground having the exceptional average thickness of nine feet and width of six hundred feet.

The number of men employed in these mines runs from five to fifty—the average being not above ten.

The ground is opened by tunnels, but as some of these have been run on too high a level to effect complete drainage, the water has to be lifted to the tunnel level by pumping. Nearly all the old channels in Butte are lava-capped, and they have to be worked by drifting, hydraulic washing being practicable in only a few localities.

Although Plumas is not largely a drift county, it contains several good claims of this class; the Sunny South and the Glazier being the most prominent. A portion of the North America has an entrance in Sierra and extends over the line into Plumas.

The Sunny South, worked by fifteen men, turned out for the year $60,000. The product of the Glazier was somewhat less. Dutch Hill, formerly a drift claim, has of late years been worked by the hydraulic process, a costly plant having been provided for the purpose.

Coming into Sierra County, we arrive at the heart of the northern drift mines, with Forest City for its center. At this place two large companies, the Bald Mountain Extension and the South Fork, have been actively operating during the past year. The North America Company, at the head of Slate Creek, have been drifting to open up new ground, of which they have large reserves supposed to be rich. The channels worked out have yielded generously for the past twenty years.

Monte Cristo and Port Wine, famous old drift camps, are likely, through the investment of much capital in their vicinity—the most of it English—to soon regain their former importance. Some of these new enterprises are already producing handsomely, and they promise to largely increase the amount in the future. Additional ground has been bonded by these and other foreign companies, and it may be expected that the drift industry will at no distant day be brought into a flourishing condition along with the entire Monte Cristo gravel range.

The Scotch company that last year bought possessions all along this range, and on the ridge between La Porte and Gibsonville, have proceeded to develop their newly acquired ground with system and care. Borings are now in progress to ascertain the proper levels on which to drive their exploring tunnels. The outlook for this company is altogether encouraging.

THE DRIFT DEPOSITS IN NEVADA AND PLACER

Are quite as important as those found in the several counties noticed. There are several prosperous drift camps in each of these counties. In the vicinity of Red Dog and You Bet, this style of gold mining gave profitable employment to hundreds of men many years ago. The business afterwards fell into decadence, and it is now undergoing marked restoration. More than a dozen claims situated near these camps, now worked with remunerative results, lay idle until last year. Little or nothing had for a long time before been done. In other parts of the county a number of drift claims have in like manner been resuscitated and are now successfully operated for the first time in several years. The Manzanita, near Nevada City, a large and steady producer for a decade or more, continues to turn out its usual complement of gold dust, its entire output amounting now to about $7,000,000, a portion saved by the hydraulic process. Toward the end of the year, the San José Company, a new enterprise, succeeded in getting their claim well opened and their hoisting and pumping machinery completed, and commenced gravel extraction under the most favorable circumstances. Their ground is a section of what is known as the regular blue ledge, of which there remains still fully thirty miles unworked.

The following are the leading mines now being worked on the Forest Hill Divide, the principal drift locality in Placer County: The Mayflower, Breece and Wheeler, Dardanelles, Baker Divide, Mountain Gate, Hidden Treasure, Golden River, Herman, Morning Star, Live Oak, and the Blue Wing. While these are the larger and more productive, there are several other live mines on this ridge. The big companies here employ from twenty to one hundred and fifty men each. In the neighborhood of Iowa Hill the Blue Wing and four or five other companies are taking out gravel in limited quantities, but all are making fair wages. The entire number of men employed amount to about fifty.

In El Dorado, Amador, Calaveras, and Tuolumne Counties some drift mining is carried on, Placerville and Mokelumne Hill being the most active centers of this class of mining.

Many drift claims were opened years ago, under the "table mountain" that traverses Tuolumne County, but the most of these enterprises proved unfortunate, and but little has been done there of late years.

RIVER-BED MINING—HOW CARRIED ON IN CALIFORNIA.

The object of this branch of gold mining is to recover the gravel forming the bottoms of river channels or streams, and known to be auriferous. To do this various expedients are resorted to, such as draining the channel, wholly or in part, subaqueous armor, dredging, etc. Where it is sought to drain the whole bed of the stream, the water is diverted by means of dams into a ditch or flume constructed along the bank of the stream to a point below the section to be reclaimed, and there the entire flow is returned to the channel. By this means such section can be so far freed from water that it is possible to control the seepage by pumps, wheels, etc. Where there exist natural facilities for running tunnels, the entire river-bed can in like manner be laid bare by such means. When the design is to dry and work only a strip along one side of the river-bed this is effected by what, in mining parlance, is termed a "wing-dam," that is, a water-tight wall which starts from the bank and is carried out a short distance into and down the river, the wall being continued back to the bank. The water inside the space so inclosed is then raised with wheels or hand pumps and emptied into flumes that discharge it into the river.

The above comprise the only methods successfully employed for river-bed working in California. The trials made with dredgers, diving apparatus, etc., have proved failures alike in our river channels and in the gold-bearing sea sands along our northern coast. To a description of these dredgers, and their operations—several of which have here been undertaken—a chapter has been devoted in another part of this volume.

While not peculiar to California, river-bed mining has been pursued here on a scale not paralleled in other countries, and the efficiency of our methods greatly surpass those employed elsewhere. Outside this State the business does not appear to have reached large proportions nor has any great amount of gold been gathered elsewhere by this method.

Working the beds of the rivers that traverse the mining regions of California was begun here at an early day. The first crop of gold dust harvested by this mode, however, was very bountiful. Like some other kinds of gold mining here, this branch of the business after having prospered and attained large dimensions underwent a marked decline. It has for several years past been on the increase, however, both as regards the number and magnitude of the operations.

While workings of this kind are pursued to some extent throughout nearly all parts of our gold fields, the Klamath, Salmon, Scott, and Feather Rivers are the localities of the largest operations.

Viewed as a whole, last year proved a pretty good one for this class of miners, the rivers along which they operate having reached a very low stage early in the summer. By the first of August the most of these miners were able to commence gravel washing (some as early as the middle of July) from four to six weeks earlier than usual—a gain that was, however, to some extent, offset by the premature advent of the fall rains, which not only brought the working season to an abrupt close, but caused much damage. The high water swept away the dams, wheels, flumes, and other portions of the miners' plant. The loss thus inflicted upon the Golden Gate Company, operating on Feather River, near Oroville, amounted to over $50,000. What rendered the flooding of their claim the more vexatious was that the company had, at the time of the disaster, just commenced gravel washing, under circumstances that justified the expectation of a large clean-up, had the rain held off as long as in ordinary seasons.

This company has, no doubt, a very valuable property. It will repair its plant next summer, and proceed to work out the portion of the river channel reclaimed, nearly one mile in extent, with all possible expedition. The improvements here were made at a cost of about $100,000, but it is the opinion of competent judges that there is a million of dollars, net profit, in the claim, to be realized in the course of two or three years, should there not be a recurrence of inopportune rains.

Another enterprise of a similar character, the site of its operations being on the North Fork of the Feather River, ten miles above the town of Oroville, and eight miles above the Golden Gate claim, is known as

THE BIG BEND TUNNEL.

That this tunnel is not only the largest, but much the most costly scheme of the kind ever completed, or even projected, admits of no question. Its length is twelve thousand feet, and its size, since enlargement, thirteen feet high, with a width of sixteen feet. It lays bare thirteen miles of the river-bed; the expenditure on the entire work amounts now to nearly a million of dollars. This tunnel, after having been completed on the original plan, being but nine feet in height, was found insufficient to carry all the water of the river, even at its lowest stage. An increase of four feet in its height was therefore necessary, the width being left as at first.

It has now capacity to carry all the water it will ever be required to take. Since the enlargement of the tunnel some gravel from the reclaimed section of the river has been worked, and yet, notwithstanding the material handled, denotes as great richness as the company had expected; operations, for reasons unexplained to the public, came to an abrupt close. More than a year has now elapsed since their suspension. When work will be resumed, if at all, we are not advised. That this abandonment is final, no one conversant with the situation believes. Many entertain the opinion that there was no need for even a temporary stoppage of work, and that suspension was ordered for purely speculative purposes. That the bed of the "Big Bend" is lacking in gold, it would be hard to make any of the old miners familiar with the history of the lower North Fork believe. This portion of the river is noted for its traditionary wealth.

THE NORTHERN TIER OF COUNTIES

Is distinguished for the many river-bed operations in progress there. The business in that section of the State is prosecuted mostly by the wing-dam system. Many of the claims are worked by the Chinese, who hold some by location, but more by purchase or under lease from the whites. Several thousand Mongolians are engaged in this class of mining in that region. For the time they are at work they make good wages. Their annual earnings are estimated to aggregate a million dollars at least. One company of these people is known to have taken, two years ago, from their claim on the Klamath below the mouth of the Scott River, over $100,000. As a rule, however, nothing definite can be learned in regard to their earnings, which are probably much larger than is generally supposed.

There are instances in which the production by some of the white companies has exceeded the above amount, though their average earnings are of course much smaller. These companies are numerous along these northern rivers. Being able to work their claims only during the summer and fall months, this class of miners turn their attention to other pursuits for the rest of the year, such as farming, lumbering, fruit growing, etc.

The following constitute the principal localities in which river-bed mining is now being carried on elsewhere in the State: Along the several forks of the Yuba, the American, and the Feather Rivers there are many small Chinese with a few larger white companies engaged in reworking the beds of these streams, the greater portions of which have been gone over and cleaned out many years ago. These river-beds have since become so much enriched through the deposit of tailings from the mines, chiefly the hydraulic washings, that they can, with the present improved gold-saving appliances, be reworked with profit.

There are here, too, some spots of virgin ground that, accidentally passed over by the pioneer miners, remain to bless the gleaners of the field.

Most of the operations along these streams, as well as at the few points further south, where any of this sort of work is being done, are carried on either by wing-damming or by diverting the water into artificial conduits along the river banks, freeing the entire channels. Recourse to tunnels for effecting the same end is had in only two or three localities.

At Horseshoe Bar, on the Middle Fork of the American River, that stream forms so nearly a loop, that a tunnel one hundred and eighty feet long, constructed two years ago, serves to drain about one mile of the river-bed. At Horseshoe Bend, on the Stanislaus River, a tunnel one thousand two hundred feet in length, driven through the neck of the bend, drains the bed of that stream for a distance of two and one half miles. The Stanislaus is a considerable stream even at its lowest stage, yet this tunnel, owing to its steep grade, is capable of taking in the entire river flow, though it has a height of only seven by a width of nine feet. At both of these localities the work of gravel washing, so far as prosecuted, has proved remunerative, and this notwithstanding these sections of the river-beds so reclaimed were extensively worked in former times.

THE FUTURE OF SILVER AND ITS EFFECTS ON CALIFORNIA.

California is not, nor has she ever been a large producer of silver. Her present annual output amounts to hardly more than two millions of dollars; it has never much exceeded three millions; the total production to date is $40,000,000. It is true, we have in this State silver-bearing deposits of great extent and value. They are not only found throughout the length of our principal mining belt, but occur also in outlying districts, and, in several, constitute the dominant mineral. It is due mainly to the low prices for silver that have ruled for many years past, coupled with its uncertain future, that these deposits have not been more largely utilized. Silver was so nearly demonetized, and the course of the Government toward it so vacillating and doubtful, that our capitalists have not felt like investing in this branch of mining, which, instead of keeping abreast with our other industries, has for several years past been retrogressing.

One of our largest silver-producing companies, whose mill was destroyed by fire four years ago, determined not to rebuild it, simply because of the unsatisfactory status of this metal. As a consequence, the mine, one of the most valuable in the State, has lain idle, and will remain unworked till there be a more favorable outlook for its latent product. This is not an isolated instance.

The consideration that weighed in this case has exerted a like depressing influence on the silver-mining industry all over the world. It is more deeply felt on this coast, because labor, the chief factor of production, is here doubly dearer than in most other countries. But were California a non-producer of silver, or were she even without resources in that direction, she would none the less be the strenuous advocate of an early and complete restoration of the metal. The views of her people on all economic and industrial questions have ever been broad enough to take in the interests not only of the Pacific Coast, but of the entire country. That these interests require the rehabilitation of silver at the earliest moment practicable, is, it seems generally conceded, no longer an open question. The wonder is that, entertaining this sentiment, people should have submitted so long to silver being embargoed. What aggravates this dishonoring of the white metal is the fact that it was brought about and has since been maintained through foreign influence and for the benefit of foreign speculators in the "commodity," for such they would make it. When this conviction, only now beginning to dawn upon the public mind, becomes clearer and more distinct, it cannot fail to beget a widespread impatience with longer delay or mere half-way measures on the subject.

The history of the precious metals during the past forty years has not been creditable to the intelligence or foresight of those who have had the direction of the world's monetary affairs. On the discovery of gold in California, followed two years later by like discoveries in Australia, these fiscal guides, fearing there would ensue an immediate and hurtful overproduction of that metal, did everything possible to work its disparagement, and gold was cheapened out of all proportion to its production. It lost, in a very short time, nearly one half its purchasing powers. In their haste to discredit it, these astute financial alarmists forgot that the population and business of the world were even then growing at a rate nearly coequal to the increment of gold. They also forgot that Mexico and South America abounded with silver mines that could readily be made to supply the apprehended relative deficiency of that metal, should it occur.

When the Comstock Mines were discovered it was a threatened glut of silver that affected these chronic alarmists, and led them to engage in a crusade against the metal, which began at once to depreciate, and has kept its downward course till, only a short time since, the lowest price on record was reached.

Ten years later, the action of Germany in compelling France to pay her enormous indemnity debt of five milliards (or five thousand millions) of francs entirely in gold, served to intensify this distrust of silver. The war waged soon after by our own Government against the white metal, dealt it another staggering blow; and all this, it will be borne in mind, without any valid reason, or even the shadow of an excuse for ostracising a money that from time immemorial had served as the principal medium of exchange, and still performs that function for more than two thirds of mankind.

When it comes to be a question of superabundance, the danger is that the repletion will be of gold rather than silver. The world's output of the former for the past decade shows a steady increase, while the yield of the latter has been falling off; the annual coinage of the United States Mints has for the past twenty years exceeded the product of the mines by more than twenty millions of dollars. For several years past silver dollars, instead of accumulating, have been diminishing in the National Treasury; and we have not more than half as much silver, per capita, as France and some other European countries can boast.

That the Council of India, sitting in London, and the creditor classes everywhere, should have favored this degradation of silver, is not to be wondered at; but that Congress, representing the largest silver-producing country on the face of the globe, should have been betrayed into a course of legislation so destructive of a great industry, and so at variance with the best interests of the whole country, is something all but inexplicable. Clearly our legislators must have been acting under a strange misapprehension of the situation. Had they studied this question of bimetallism more closely they certainly would have been impressed with the importance of extending to the business of mining for both gold and silver in this country every encouragement.

While our population is being increased at a rate that doubles it every twenty-five years, the growth of all our leading industries being in nearly the same ratio, the increment of the precious metals is comparatively slow—only about 3 per cent per annum for the past ten years. The output of our coal, copper, lead, petroleum, and most of the other useful minerals and metals has been enormously increased, our cereal crops have expanded, our flocks and herds multiplied, and railroad construction accelerated year by year; but with all this forcing ahead in other directions, mining for the precious metals has nearly stood still, and as far as the silver branch of the business is concerned, mainly because it has been crippled by unfriendly home legislation. That this American product should have been assailed and hurt is not so intolerable, but that it should have been "wounded in the home of its friends," seems a grievous wrong, and one hardly to be borne.

It must be apparent to all observant and intelligent persons that the time has come for correcting the errors of Congressional legislation, and repairing as far as may be the mistakes of the past. This is a point on which there is hardly room for two divergent opinions. Events have taken it out of the category of debatable questions. The partial demonetization of silver has cost the country, so far, about two hundred and fifty millions of dollars, and it is time to call a halt. Having paid so dearly for the experiment, it can hardly be expected that the country will go on with it; the monometallists must, by this time, see the folly of further opposing the restoration of silver to its former standing, because this result is as sure to be reached as the occurrence of any event in the future. The expectation that this will soon be brought about has had a marked appreciation in the value of the metal, the price of which has advanced within the past year from 91 to 95½ cents per ounce. With free coinage at the rate of four millions of dollars per month—the maximum permissible under the present law—there is little doubt silver would soon reach par, $1 29 per ounce.

It is a mistake to suppose that silver is unpopular here or anywhere else in the world. It has always and everywhere been the "money of the people," having been used as such from the earliest historic times, and is now the common currency of three fourths of mankind. In the records of our race it has earlier mention than gold. In biblical history, its money function is spoken of at a very early date. Abraham, the patriarch, when he bought a burial place for his family in the field of Machpelah, weighed to Ephron the "silver current with the merchants," that paid for it. The white metal from that period to the present has, in conjunction with gold, served as a measure of values the world over, the former having been especially favored for this purpose by Oriental people, among whom, however great the production, it will always find an outlet. And it is the case that most of the silver sent to central and eastern Asia stays there. These countries open for it a market that can never be surfeited or even satisfied. Their inhabitants, comprising more than half the population of the globe, not only employ and prefer silver as their common money, but even the poorest among them use much of it for ornaments, and the wealthy have it manufactured into plate as well; all hoard it with fanatical care. Asia is a maelstrom from which silver once swept into it never returns. How far can the world's annual production of silver (hardly more than $100,000,000) go towards satisfying the wants of people so multitudinous, after such production has been reduced by the large and constantly increasing needs of the rest of mankind? Were the amount twice as great as it is, it would be easily absorbed by the cravings of these countless millions of the Orient, who prefer it to gold.

A large silver circulation carries with it this further advantage: it promotes among the masses a disposition to hoard; in other words, to economize and treasure up this form of wealth—a practice that ought to meet with every encouragement, especially among a spendthrift people like ours. None of us have the same confidence in paper money that we have in a hard currency.

The paper may easily be destroyed, or, through causes incidental to human affairs and of frequent occurrence in the fiscal world, its value may depreciate or be lost altogether. Not so, however, with the royal metals; they cannot be wholly destroyed, nor can they, under ordinary circumstances, suffer much depreciation; hence their great fitness for storing and handling against a time of need.

As regards the treatment of silver, the United States can now safely adopt a policy of its own. Be that policy what it may, other countries will soon conform to it. From the start it might count on the concurrence of all the American republics; nor could the European Governments, in their purchases of silver, fail to become our customers. England, especially, would have to buy largely of this metal from us, as she uses many millions annually in her dealings with India.

Judging from the signs of the times, it will not be long before all Europe will adopt the bimetallic system of currency, and the probabilities are that England herself will lead the movement in this direction.

When the white metal shall have met with proper recognition, California will begin to produce it in greater quantity; the favorable indications noticeable have already imparted some additional life to silver mining in this State. With silver at par, or subjected to the same rules that govern the coinage of gold, our annual output of the metal would be doubled in a single year, and thereafter advance at a rapid rate. There is no reason why it should not, under such conditions, be increased, in the course of another decade, to ten or even twenty millions of dollars per annum, with the chance always of deposits being struck that might raise production to much higher figures.

OUR GOLD BLUFFS AND BEACHES.

Besides those already mentioned and partially described, the gold-bearing deposits of California occur in several other forms, all designated by names more or less fit, a few being perhaps a little fanciful. The most of these deposits are, in fact, distinguished not so much by any inherent peculiarities as by the conditions under which they are found and the methods and appliances adopted in working them.

The auriferous beach sands, which once afforded profitable employment to many men, have years since become so impoverished that they figure no longer among our available mineral resources. These ocean placers have, in fact, responded so feebly to the attempts made of late to work them that beach mining may be ranked among our extinct industries. But, for all this, we have these deposits of low grade in infinite quantity occurring at intervals. They reach along the seashore for many miles, extending at several points, in the form of buried channels, some distance inland. So abundant, but now so poor, these gold-bearing sands await the coming machine that is to make their further working profitable. Many machines claiming the ability to do this have already been invented and tested, but none of them have fully, or even more than partially, met the requirements of the case.

Meantime the auriferous beaches continue to be worked at a few points and in a small way. Along the seashore in Humboldt and Del Norte Counties, formerly the chief sites of this class of mining, the residents of that section of the State gather from these sands by hand sluicing a little gold every year. Their earnings are small and their labor intermittent, being prosecuted only when they have water for washing, which in most localities is the case during only a small portion of the year.

Along the shore further south some little work of this kind is also being done. Between Point Sal and Point Concepcion, off the coast of Santa Barbara, several small companies have been engaged in washing the beach sand during the past year, about twenty-five men having been so employed altogether. The employing companies, finding that white labor at $2 per day would not pay, were obliged, in order to continue operations, to engage Chinamen at half that rate. With this cheaper labor, washing at the point still goes on, it being understood, however, that the net profits realized by these companies are small. At Soquel, in Santa Cruz County, about a dozen men have been operating the past year in a manner and with results similar to those above set forth. The foregoing comprise about all that is now being done in the way of handling these beach sands. The attempts made at washing them some years ago in the vicinity of San Francisco proved so unsatisfactory that they were after a short trial abandoned. Efforts made at a still later date to utilize deposits of this kind found in the bed of the Tia Juana River, on the southern border of San Diego County, have a similar history, nor has anything in this line since been undertaken at either of the above localities.

At the locality known as "Gold Bluff" but two companies have been operating for many years past. These are, in fact, the only parties that have ever made any large production at that point. These companies, the Pioneer and the Union, own each four miles of the beach, which cover nearly the entire deposit lying under and constituting the workable portion of the "bluff." The Union Company has been carrying on operations steadily for more than twenty years, making an average annual production of $25,000, over 30 per cent of which has consisted of net profits. For several years past the Pioneer Company has been doing but little, the property having been much of the time bonded to parties who were seeking to negotiate a sale of it. The death of the sole owner not long since was a cause of prolonging this state of inaction. Connected with this property is an important water franchise, which affords means for hydraulic washing and adds much to its value.

Besides these "gold bluffs" and "beaches," we have in California a variety of other auriferous deposits, some of which, like the gold bluffs, are peculiar to the State; nor do more than a few of the others meet elsewhere with such large development as here. The principal of these deposits, designating them by the local names, consist of the following, viz.:

THE DRY AND THE SEAM DIGGINGS, THE CEMENT, POCKET, AND TAILINGS DEPOSITS, NUGGET MINING, CREVICING, ETC.

The Dry Diggings, so called, are simply such surface placers as, being without a sufficient natural supply of water for washing, cannot be supplied by artificial means. There are many localities of this character in California. In cases of this kind, if the auriferous earth is not rich enough to bear transportation to water, the gold is separated from it by "dry washing," a process formerly conducted by means of the Mexican batea, still employed in some places. By the Spanish-speaking races the batea continues to be exclusively used in the "dry diggings," and these people are very skillful in handling it. Latterly, dry washing machines of various kinds have been invented, some of which are efficient; as much so, in fact, as can reasonably be looked for, considering the inherent difficulty of the work. An entirely satisfactory "dry washer" remains, however, a desideratum. There are in this State extensive deposits for the working of which the "dry washer" alone is adapted, but these remain little utilized, owing to lack of a more effective machine of this kind. These deposits occur mostly on the Mojave and the Colorado deserts. Some are met with, also, in Los Angeles and San Diego Counties. When found further north they are situated, for the most part, in small gulches and flats, often at considerable altitudes.

The Seam Diggings consist of narrow veins of auriferous quartz, varying from not more than half an inch to an inch or two in thickness, found in this State occasionally traversing other formations, and which but for their extreme richness would not justify the expense attendant on extraction. Carrying so much gold as they do, the working of these veins has generally proved remunerative. The weak point about these "razor blade" veins, as they are called, is their unreliable character; seldom do they extend to any great depth, nor does their wealth of gold always run with their downward continuity.

The best paying deposits of this kind were found some years ago in Greenwood Valley, El Dorado County. They yielded largely for a time, but are now pretty well worked out. In the South Fork District, Shasta County, occur many of these narrow veins, their average thickness being about three inches. They are not so rich, but they go deeper here, more generally than has elsewhere been the case, some of them carrying their usual quantity of gold, and holding it for forty or fifty feet before the inclosing granite pinches them out. In this locality the ore taken out is worked in arrastras; there have for many years been five or six of them running in the district, earning for the owners very fair, and, occasionally, large wages. These machines are driven by water, and crush from two to three tons of ore per day. As a rule, the quartz mined in the "seam diggings" is worked in hand mortars; its small quantity and great richness rendering this the most desirable method for its reduction.

The Cement Deposits are composed of the indurated gold-bearing gravel taken from the hydraulic and drift mines, mostly from the latter, and which, owing to its hardness, has to be crushed with stamps. This indurated gravel is met with more largely in the southern than in the more northerly drift mines, seventy-five of the hundred stamps employed in crushing it being in Nevada and Placer Counties. As the hydraulic washings approached bedrock more of this material was encountered, and but for the check put on this class of operations, twice as many stamps as are in use at present would probably be employed crushing cement.

"Pocket" Mining consists in the exploitation of that class of quartz lodes in which the available ore occurs mostly in the form of rich bunches or "pockets." While these bunches are apt to be much scattered, occurring only at long intervals, this is sometimes a lucrative branch of mining. Its grand chances prove very alluring to the more adventurous class of prospectors. While rich pockets have been encountered in the quartz lodes in all parts of the State, and throughout the entire history of mining, Tuolumne County has been most distinguished for deposits of this kind. From what is known as the Bonanza Claim, near the town of Sonora, there was claimed to have been taken, during the four years preceding 1882, nearly $1,000,000, all realized at small expense—not more than half a dozen laborers were employed. Since that time the claim has yielded, it is stated, with equal net profit, about as much more. Since 1852 this neighborhood has been noted for finds of this character. During that year a party of Mexicans took out on Bald Mountain, two miles north of Sonora, as much gold as would load a mule, but exactly how much was never known. Near Littletown, a few miles south of Sonora, two miners recently came upon a nest of these "chispas," and have since gathered over $100,000 worth, with more in prospect. From a claim at Don Pedro's Bar, in this county, there was taken, some years ago, the sum of $100,000, at a cost not to exceed $5,000. From the Morgan quartz claim, on Carson Hill, just over the line in Calaveras County, there was, in the early fifties, pounded out with a hand mortar and pestle, gold valued at $3,000,000.

With such results extending through so many years and scattered all over the State, it is not strange that this exploiting for pockets should be with many a favorite style of mining.

Hunting for "Nuggets" is carried on in both vein and placer deposits. The greatest success of late has been met with in the latter. During the past year Appel & Grant, working their quartz claim at Chip's Flat, Sierra County, it is recorded, took out in a few months, and with little more cost than their own labor, over $100,000 worth of nuggets, besides large quantities of rich ore not yet reduced. From the Baughart Mine, located twelve miles northwest from the town of Shasta, there was taken, several years since, a large number of nuggets which weighed over a pound each, besides many of lesser weight. From a placer claim situated on the Monte Cristo gravel range there was taken, last summer, a lot of nuggets ranging in value from $300 to $800 each. These nuggets much resembled in size and form small cobble-stones.

Crevicing means hunting after and digging out the free gold that makes lodgment in the small seams or crevices, whenever found. The implements used for the purpose are a stout knife and a scraper, supplemented, where necessary, by the pick. Though pursued to some extent in vein mining, it is more practiced in cleaning up the bedrock in hydraulic, drift, and other forms of placer mining. Rewashing the tailings discharged from the quartz, hydraulic, and other kinds of placer operations, of which such large quantities have been lodged along the outletting streams, has not yet been carried on to any great extent. There is little doubt, however, but that this waste material will yet be handled in an extensive manner and with satisfactory results, as much of it is known to contain a fair percentage of gold. Like the beach sands, these deposits await the machine that will insure their being handled on a large scale and in an economical way.

RECOVERING AURIFEROUS GRAVEL FROM SEA BEACHES AND RIVER BEDS BY MEANS OF DREDGES, SUBMARINE ARMOR, AND OTHER APPARATUS.

Dredging river beds as a method of gold gathering was undertaken at various localities on this coast in the early history of California mining. Although most of these attempts were signal failures, and in no instance was there any great success, they have frequently been repeated, generally at long intervals, both here and elsewhere on the Pacific Coast. An effort of this kind was made on the lower Yuba River, early in the fifties; a pioneer attempt, and, it may be added, a pioneer failure also in this department of gold mining. The gravel in this instance was brought to the surface with a bucket dredger of the ordinary kind by means of a machine placed on a scow moored in the river. The bed of the stream where operations were carried on was filled with sediment, there were no rocks nor heavy bowlders to interfere with the work. The dredger easily brought up the stuff in large quantities; but on being washed in the sluices placed on the scow for the purpose, it was found to carry too little gold to warrant prosecuting the work, and it was accordingly abandoned. The experimenters were out of pocket a good many thousands of dollars. They were not only disappointed in the result of their search for gold, but were left with a worthless apparatus on their hands that, originally, had cost them a great deal of money.

Another trial of the same kind, conducted by similar means, and which eventuated in the same way, was made many years later, the scene of operation this time being the shallow water off Gold Bluff. The object

was to recover and wash the auriferous sand found in great quantities near that point.

Even as early as the summer of 1849, the idea obtained that the gravel in the river beds of California was rich in gold. Attempts were made to reach and bring it to the surface by means of subaqueous armor; an apparatus of that kind was constructed and experimented with near Sutter's Mill at the time mentioned. The trial came very near costing the adventurous diver his life.

The machine is said to have been constructed at an expense of $700, and it did its work to perfection. The operator succeeded in filling without difficulty two half-barrels, taken down to hold the gold sands, with leaves and other rubbish strewn over the river bottom. The early mining history of the State abounds with stories of such trials, the outcome of which was failure.

Coming down to later times this kind of experimentation seemed to revive, though in none of the more recent trials has the practical difficulties before encountered been more than partially overcome. Two years ago an attempt was made to take up the gravel from the channel of the Stanislaus River, in Tuolumne County. The means employed were a powerful fan suction-pump, worked by a steam engine, the whole being placed on a boat moored in the river. In operating, a length of suction-pipe connected with the pump was lowered to the gravel. On starting the pump, sand and gravel, with much water, were raised and emptied into sluice-boxes placed on deck, the discharge being continuous. When necessary, divers in subaqueous suits went down to the river bottom and cleared away bowlders too large to pass through the pipe, also loosening with picks gravel too hard to be affected by the force of the pumps, although they were able to take up stones weighing seven or eight pounds. At last accounts it has been found impossible to clean up the river-bed in a satisfactory manner by this method; but it was thought the enterprise would eventually succeed.

About the same time a company was formed to dredge the channels of the Yuba and Feather Rivers with the Falcon centrifugal pump, a very powerful machine operated with a steam jet, supplemented, when necessary, by the aid of divers in subaqueous armor.

Though some progress is said to have been made in the way of preparation, this company has not yet got actually to work, nor are we advised as to what they are likely to do in the future.

That the Falcon pump will perform the work required seems probable, as its effectiveness has been established by crucial tests on western rivers.

Three years ago Dr. Roe had a dredger constructed, in some respects after the style of these already mentioned, intended to raise quartz mill tailings lodged in great quantity in the bed of the Carson River. The first machine built was for experimental purposes, and not only performed its work well, according to report, but demonstrated at the same time the great richness of the Carson River tailings in quicksilver, sulphurets, and amalgam. However this may have been, it does not appear that this experimental machine was followed by the construction of one of larger capacity, nor, so far as can be learned, did this preliminary trial result in any positive success. The present status of the enterprise is unknown.

WHAT HAS BEEN ATTEMPTED IN OTHER COUNTRIES.

While experimenting with dredgers, pumps, and divers on this coast has been attended with such indifferent success, trials made elsewhere appear, in most cases, to have reached better results. In New Zealand, for example, operations of this kind have been carried on for fifteen years both along the interior rivers and on the sea beaches of the country; great stretches of the latter are auriferous. The success attained, as yet but partial, has been achieved only after numerous trials persisted in through the long time mentioned. During this period many machines of different styles and operated on different principles were used, such modifications being made in them as experience suggested. Some engaged in the business employed the old fashioned bucket, and some the centrifugal pump-dredge, the former being now, in many cases, supplemented by the latter. The chief inspecting engineer of the New Zealand Government expresses confidence in the ultimate success of these machines, but at the same time he is of opinion they are too small, as well as deficient in power. The appliances for separating coarse shingle from the fine sand before it goes over the washing tables have also been found insufficient. He approves, however, of the principle on which the machines are constructed, and expects they will soon be so improved as to adapt them completely to the handling of ocean-beach sands, at least; for working river-beds the simple bucket-dredge is preferred.

Those that have done the best service in New Zealand, and have been the longest in use, are of that pattern.

The Secretary of Mines (N. Z.) reports that a number of these machines have for the past six years been successfully operated on the Molyneux River; and, also, that many of the centrifugal pump dredges have for several years been doing satisfactory work on ocean-beach claims. By reason of the measurable success that has attended these various enterprises, more powerful and otherwise more effective dredges are being built in New Zealand, where this mode of gold mining would appear to have an encouraging future.

Our own people might, perhaps, be able to learn a few lessons from the New Zealanders' methods that would be of use in future exploitation of the auriferous river-beds and ocean beaches of California.

There are plenty of such places here if we had the machinery properly adapted to the work.

In various parts of South America, the conditions of the rivers would seem to be favorable for operations of this kind. A number are now in progress in that country; they have not been conducted, however, on a large scale, and only a few of them have been attended with any marked success.

The river-bed sand is brought to the surface mostly by native divers, who, by constant practice, are able to remain under water long enough to fill their bateas and even much larger vessels with the sands that carry a large percentage of fine gold.

Wm. Irelan, Jr., *State Mineralogist, San Francisco, Cal.:*

Dear Sir: In compliance with your request that I report to you relative to the geological survey now being prosecuted by you, permit me to give a brief summary of the status of past surveys, their results, the necessity for more methodical and systematic work, the scope of the present survey, the extent of completed work, and such other facts as come within the sphere of the labor of my department.

I respectfully submit that the public generally are not sufficiently informed concerning the necessity for, and great benefit of, a thorough knowledge of the geology of our country.

Geology, as defined by the eminent geologist, Professor Joseph Le Conte, is, "in a word, the history of the evolution of the earth and its inhabitants," or more fully, "the history of the earth and its inhabitants, as revealed in its structure and as interpreted by causes still in operation."

Further, Professor Le Conte says there is no science which requires for its full comprehension a general knowledge of so many other departments of science—a knowledge of mathematics, physics, chemistry, mineralogy, lithology, zoölogy, and botany—as are required to equip one for thorough geological investigation.

The impression that the study of geology is of little immediate benefit or practical use is as erroneous as it is common.

It is true that valuable minerals, and especially gold and silver, have been found in formations, in which, according to the geological knowledge of the particular period, they were not expected to occur, but it is also true that geology invariably leads to valuable discoveries and might have led to much greater but for the erroneous prejudice mentioned.

The discoveries of the copper mines of the Lake Superior District, which have yielded many millions of dollars in dividends, were the direct result of scientific research and deduction.

The prognostications of Baron Lichthoven, relative to the mines on the great Comstock Lode, proved to be correct, and the work undertaken on the basis of his views proved successful.

The actual proof of the existence of gold fields in Australia was the work of a practical gold hunter, not of a geologist, yet this discovery might have been made years before if the word of the celebrated geologist, Sir Roderick Murchison, had been taken as the probability of such fields existing in the southern continent, and Australia might in consequence have been to-day far in advance of her present development as an inchoate nation, magnificent though that development is.

The governments of the various colonies have become so fully alive to the value and importance of geological knowledge, that they have devoted a large share of the public revenue to such investigation, with the result that Victoria at least has long been far in advance of California in the matter of a geological survey, and prospectors can easily ascertain the general character of any district which they may desire to visit by an inspection of the complete geological maps in the Government offices. It is true that, in a few instances, prospects which have been condemned by persons claiming to be geologists, have afterwards proved to be valuable, but it would be unwise to hold the science of geology responsible for such errors of individuals, who may not have been competent geologists. It is not the province of geology to pronounce upon the results of individual mines or prospects, but rather to indicate the probabilities or possibilities of definite regions as to the class of valuable rocks or minerals which may be found.

For example, the geologists of Australia have observed that in those parts of the country in which the Laurentian rocks prevail the quartz veins are only auriferous, or at least "payable" within or in the vicinity of intrusive dikes, so that prospectors need not lose their time in searching elsewhere for good "stone."

The necessity for a systematic and complete geological research and surveys of all the portions of the globe on which we live is unquestioned. For centuries such work has been elaborately and exhaustively prosecuted in all the enlightened and progressive portions of the world at enormous expense. The unremitting energy employed and the large expense incurred in the geological investigations and surveys of what is designated as the Old World amply demonstrate that such results have been obtained from the expenditures made for such research as to clearly show the inestimable advantage thereof to civilization and to science. In each State and Territory of this Union, either by the General Government or by the States, or by each, geological surveys have been more or less vigorously carried on for a long period of years, with beneficial results proportional to the accuracy and completeness thereof. But in this, our famed, fruitful, and favored California, the greatest and most profitable field for such research, geological surveys and investigations have been conducted only in a spasmodic and incomplete manner. The geology of this State is not complex but is greatly diversified, and a complete knowledge thereof is as necessary to the people as it is simple to obtain.

Permit me to quote the following cogent reasons for the necessity for thorough geological research, as advanced by J. D. Whitney:

> *First*—To furnish a basis for detailed explorations for farther deposits of metallic and mineral treasures, by limiting the field of research for the numerous prospectors always engaged in the search for useful ores; so that every man will be working where his labor will tell, and not throwing it away on undertakings which a comprehensive view of the mode of occurrence and geological position of our economically valuable materials will show to be a mere waste of money, time, and energy.
>
> *Second*—To insure permanent working and economical development of what is discovered, by giving every one the means of knowing beforehand how his discoveries may be turned to the best account, how much it will cost to open his mine, how much to reduce his ores, what form to give his products, and where and in what quantity they can be disposed of. On subjects of this kind, we are constantly applied to for information, and are always ready to advise to the best of our ability. And, if not now, we shall, as we become more fully acquainted with all the necessary conditions, be able to render essential service in this line, as our statements will be recognized as being based on extensive researches, and entirely disinterested; and in our final report we shall throw all possible light on these subjects, so that it will not be our fault if the man about to embark in any enterprise, connected with ores or mineral substances, will not find in our work something which will materially aid him in his undertaking, or at least prevent a foolish waste of money on the impracticable.
>
> *Third*—We need a geological survey, in order that the resources of the State may be made known to the world, under official guaranty of correctness, and in detail, so that not only our own capitalists, but those of other countries, may have opened to them a field of investment, in regard to which they will be possessed of such definite information that they may feel that they are not entering on a blind speculation when putting their money into a mine.
>
> *Fourth*—We need such a survey as was contemplated by the Act under which we commenced our work, in order that the educational interests of the State may be advanced—our schools, colleges, and University furnished with a scientific basis for instruction in the different branches of geology and natural history, and with text-books in which the necessary information may be found as to the forms of animal and vegetable life occurring on the Pacific Coast.
>
> *Fifth*—We need a geological survey, in order to show to the world that the State is willing to contribute something towards the advancement of science, and that we may not be subjected to the mortification of having the rich harvest of facts which California spreads out before us left ungathered, or only partially reaped, for the benefit, and by the efforts of other States and countries.

Admitting the necessity for such survey to exist, for the reasons heretofore enumerated, allow me to give a synopsis of the history of the geological surveys of this State.

Apparently, the first exploring expedition to visit California and treat upon the geological characteristics of the State was under Captain Chas. Wilkes, prosecuted during the years 1838–42, inclusive. The geologist of this expedition was Mr. James D. Dana, whose published reports are well known.

From 1840 to 1842 Duflot de Mofras made quite extensive explorations in California and Oregon and the Vermillion Sea, his reports having been published in Paris in 1844.

In 1843–4 the "pathfinder," John C. Fremont, made some quite elaborate geological explorations in California, Mr. James Hall having been the geologist, whose report was published in the appendix of 1845.

In 1849–50 Bayard Taylor made some investigations of a geological and mineralogical nature.

The first report of the geological characteristics of California, after the discovery of gold, was a brief one to the Secretary of War, by Philip T. Tyson. Subsequently, James S. Wilson, a practical gold miner, published an article on the same subject in the "Quarterly Journal" of the Geological Society of London.

In 1853–4 the United States Government equipped an expedition to explore over a route for a railroad from the Mississippi River to the Pacific Ocean, under the orders of the War Department.

Mr. W. P. Blake was appointed mineralogist and geologist of this party and made some very accurate observations and reports of the same, relative to the geology of California, which were published as a report of the geological reconnoissance in California, etc., in 1858.

An article on the extent and geology of the gold-bearing belt was published in the "American Journal of Science," in 1860 and 1867. Professor Blake was appointed Geologist of the State Board of Agriculture in 1866.

On the fifth day of March, 1853, the California State Legislature passed a joint resolution requesting John B. Trask to furnish such information as he might possess relative to the geology of the State; the result of which was a report on the geology of the Sierra Nevada, or the California Range. On the sixth day of May of the same year, a resolution was passed authorizing further geological examinations of some parts of the Sierra Nevada and Coast Range.

Dr. Trask was appointed the first State Geologist. An eminent French geologist, Jules Marcou, visited California in 1854, and reports of his investigations were published in the "Bibliothequé Universal de Genéve," in 1855.

A third report of the State Geologist was presented in 1855. The fourth in 1856. In 1860, an Act of the Legislature, approved April twenty-first, by John G. Downey, Governor, created the office of State Geologist, by the first section of the Act. Professor J. G. Whitney was made such officer. The history of the survey of Professor Whitney is too well known to require comment here; and the Legislature of 1873–4 declined to make further appropriation for the prosecution of this survey and discontinued the same.

The publications of the Whitney survey are:

Geology, vol. 1, 1860–64.
Paleontology, vol. 1, 1864.
Paleontology, vol. 2, 1869.
Ornithology, vol. 1, 1870.
Botany, vol. 1, 1880.
Botany, vol. 2, 1880.
Contributions to American Geology, vol. 1. "Auriferous Gravels of California," 1880.
Yosemite Guide Book, 1870.

Several other publications of minor importance were issued by the survey, such as bulletins, catalogues of shells, fossils, etc.

The foregoing history evidences the unmethodical, diffuse, and limited extent of the geological surveys of the past, which were brought to a sudden termination in 1873–74 by the failure of the Legislature to make any further appropriations. Thus was a great, necessary, and economic research brought to a summary conclusion, by aid having been refused to the eminent geologist, J. D. Whitney.

Mining was the greatest and most profitable industry of this State from its infancy to a very recent period, and the mineralogical characteristics of the geological survey most quickly inured to the benefit of the people. Mining is still an important industry of this State and should be recognized as entitled to great consideration at the hands of our law makers. Although mining has contributed enormously to the glory, prestige, and wealth of this State, in return little has been done for that industry. Large and frequent appropriations are made to promote and aid agricultural interests and pursuits, but, until recently, little in the interest of the miner, notwithstanding the fact that since 1848 there has inured to the State an average annual return of nearly thirty millions of dollars, not as a mere result of exchange in the busy marts of trade, *but a clear addition to the wealth of the world* as well as the State, wrested from the depths of the earth by the tens of thousands of patient toilers thereby afforded profitable employment, until the session of the Legislature of 1888. Such has been the history of geological surveys by this State, and such has been the treatment of the great industry, mining.

At this session of the Legislature wise counsel prevailed, and a determination to again resume and prosecute to a complete conclusion a comprehensive geological survey of this State caused the passage of the present Act.

By the terms of this Act $70,000 was to be used for geological work in the field, and to be used as a beginning for a thorough geological survey of the entire State, embracing everything properly pertaining to geological research and representation.

Owing to the magnitude and expense attending a thorough treatment of this great subject, it will be necessary to so segregate and arrange the plan of procedure as to give to the public the most important, practical, and economic data first, and, in the order of their importance, investigate and treat upon the various characteristics and departments of the geology of the State.

The general geological and mineralogical data should be first treated, such as the ages of various formations, their range and extent, the position which they occupy on the surface, and their relations to each other; also the location of each group of strata, with a determination of their geological ages and status, together with the lithological peculiarities of each. Also to delineate and define all geological characteristics upon a map in the position in which their outcrops occur upon the surface. Without an accurate map no correct or complete geological representation is possible, and as a basis for such representation a complete and accurate topographical map is absolutely necessary.

As instructed by you, I have now in process of construction a topographical map of this State on a scale of twelve miles to one inch, which will be complete and accurate in every detail, embracing the obtainable results of every topographical, geological, United States Coast and Geodetic, railroad, public, and private surveys of the past. I respectfully recommend that this topographical map, which will accompany your annual report for 1890, be published as such, and that all geological annotation and definition be made upon subsidiary sheets exactly corresponding to the topographical sheets, but containing only so much topography as may be absolutely necessary, thereby rendering more clear and distinct the defining of all geological characteristics.

As, owing to certain complications, the funds for the prosecution of geological work were not available until September of this year, it was only possible to obtain about two months' work of the assistants in the field, hence only a small amount of data has been accumulated for delineation upon the map; but inasmuch as the same can be put upon the map much more rapidly than it can be gathered in the field, this is no disadvantage. Also, the topographical map must of necessity be nearer completion than now, before the subsidiary sheets can be prepared for the geological representation. Inasmuch as you determined to begin and have commenced the geological survey at the southern boundary of the State, and have ordered that it be continued northward, systematically, I have likewise commenced the completing of the map at the same place, and will have the work advanced with the field work from the south northward.

I have requested each assistant in the field to connect each and every geological characteristic with the nearest Government segregation survey corner, and carefully note directions and courses of same wherever practicable, in order to attain the greatest degree of accuracy possible in the delineation of each upon the maps, and find that they have thus far done so.

At present there is no correct or complete map of this State, all being defective and erroneous in so marked a degree as to render them misleading and valueless where any accuracy of information is desired. Therefore, the compilation and giving to the public of an accurate and reliable map, containing all data collectible up to the date of its publication, will be a contribution to the public of inestimable value. In addition to the topographical map as described, which can be corrected and added to from year to year, and maintained as the authentic map of its kind, the subsidiary sheets, containing the geological characteristics, will be successively completed as the work progresses, thereby giving to the public and the scientific world at large most valuable and exhaustive data in a most compact and comprehensive form.

In conclusion, permit me to submit that all intelligent peoples of the world recognize the wisdom and economy of thorough geological research and surveys. That we are woefully wanting in knowledge of this character concerning California, and should proceed as expeditiously as possible to obtain it. That to obtain this information an elaborate and systematic survey is necessary. That to properly give to the public the results of such survey a topographical and geological map is needed. And, finally, permit me to congratulate you upon having under auspicious circumstances effectually entered upon the collection of geological statistics in so methodical a manner as to guarantee most satisfactory results.

Respectfully,

HARRY I. WILLEY,
Engineer.

SAN FRANCISCO, December 31, 1889.

WILLIAM IRELAN, JR., *State Mineralogist:*

SIR: In answer to your letter, I have the following statement to make regarding my work, and the report which I have undertaken to prepare for your next annual report.

This work will consist in a detailed examination and careful survey of the drift mining districts of the Forest Hill ridge in Placer County, covering about twenty-five miles of the ancient river system.

The earlier developments in this section were confined to the more accessible portions of the ancient channel beds. The amount of gold produced has been estimated at from $25,000,000 to $30,000,000, and the greater part of the ridge still remains untouched. Many of the claims being worked out or proving unprofitable, were abandoned, and the openings have been filled by caving, etc. Information, which it cost large sums of money to obtain, and which might have furnished a valuable guide in subsequent undertakings, was lost for want of a proper record. It has been necessary to repeat a great deal of prospect work merely to test the memory of predecessors.

Of late years a number of bolder enterprises have been started with the object of attacking the more deeply buried portions of the ancient channel system. It is difficult to obtain reliable data, and large expenditures are made in determining the location, course, and depth of the channels. It is not unusual for a company to expend $100,000 or more before determining the exact location, or even the existence of a pay channel within the boundaries of its property.

It becomes important to collect and record all available data, and connect, by careful survey, all surface exposures and underground developments while still accessible, with the ultimate view of throwing more definite light upon the relative position and characteristic features of the channels of the various periods. The subject is one of economic importance, as well as scientific interest.

It is also important to publish, for the convenience of the projector of new enterprises, the experience had in the better worked drift mines in methods of opening up the mine, extracting and working the gold-bearing gravel, etc.

I shall endeavor to make my work meet the requirements above indicated.

Accompanying my final report to you, will be a carefully prepared map showing the principal developments in the channel system of the Forest Hill divide.

Respectfully,

ROSS E. BROWNE.

Minerals found in the State, not heretofore in the Museum collection, excepting as donations from foreign sources:

Anthracite. Found in Butte County, eight miles from Oroville, by Mr. E. Duncan.

Antimony (native). Kern County, seven miles from Kernville and Havilah.

Bismuthinite, sulphuret of bismuth. Minarette Mountain, Fresno County.

Bismutite, hydrous carbonate of bismuth. Found in vein, Fresno County, Big Pine, and Antelope Spring, Deep Spring Valley. There is another specimen in the Museum which was found in sluicing, but the above is the first known to have been found in the State in ledge matter.

Calamine, silicate of zinc. Found in Cerro Gordo, Inyo County, and in San Bernardino County.

Caledonite, cuprous sulphate carbonate of lead. Found in the Union and St. Ygnacio Mines, Inyo County.

Celadonite, green earth, hydrous silicate of iron and potassium. Found in San Mateo County, on the San Gregorio Ranch.

Celestite, sulphate of strontium. Found in San Bernardino County, near Calico, and in Death Valley.

Chloropal, hydrous silicate of iron. Found in Placer County.

Chrysophrase, an apple-green chalcedony, colored by oxide of nickel. Found in beautiful green color near Visalia, Tulare County, by M. Braverman, January 6, 1888; Inyo County, Union Mine, St. Ygnacio, and others.

Columbite, columbate of iron, niobite. King Creek District, Fresno County.

Coquimbite, white copperas neutral sulphate of iron oxide. Found in Lone Pine District, Inyo County.

Flint, stink-quartz; silica 89, bituminous matter 10. Found in San Luis Obispo County, also in Santa Barbara County.

Fluorite, fluorspar. Found in New Almaden (in white modified cubes), Santa Clara County. White purplish. Found in northwestern part of San Bernardino County.

Fuchsite, cromglimer chrommia. Found two miles back on mesa from Arch Beach, Los Angeles County.

Gilsonite, a new hydrocarbon; sp. gr. 1.0505, and 1.05743 at 62° Fahrenheit. Found in Santa Barbara County, near Sisqua Post Office, on the land of Mr. Goldtree, of San Luis Obispo. Black shining luster; brittle; gives a brown powder; sticks to the pestle; burns with a fine flame, black smoke; has the odor of asphaltum; leaves no ashes; non-conductor of electricity and heat; naphtha and ether soften it only with intumescence; alcohol, mineral acids, and alkaline solutions have no effect on it; vegetable and the heavier petroleum oils at ordinary temperature soften it, and with heating unite with it; chloroform dissolves it, but spirits of turpentine dissolves and unites with it. One pound gilsonite in five pounds spirits of turpentine gently heated makes an excellent japanning varnish. Applied to metallic surfaces and then baked, becomes quite hard. The same varnish, mixed with half a pint of oil, renders some fabrics waterproof, and will be flexible when the varnish is perfectly dry.

Hausmannite, black manganese, pyramidal manganese. Found near Auburn, Placer County.

Hessite, telluride of silver. Found in Shasta County, in Sherer & Rattler Mine.

Jarosite, sulphate of iron and potassium. Found in New-Almaden quicksilver mine, Santa Clara County.

Melanterite, sulphate of iron. Found in Monterey and El Dorado Counties.

Mesolite, lime and soda mesotype, silicate of alumina, lime, and soda. Found in Modoc and Lassen Counties.

Mimetite, arseno phosphate of lead. Found in Cerro Gordo, Inyo County.

Minium, red oxide of lead. Found in Tulare County.

Mirabilite, sulphate of soda. Found in San Bernardino County.

Molybdenite, sulphuret of molybdena. Found in Sweetwater Range, Mono County; Fresno Flat, in Fresno County; White Mountain, Inyo County; also in San Bernardino and Tulare Counties.

Natrolite, silicate of aluminum and sodium. Found in Peru Mining District, Los Angeles County.

Orthite, silicate of aluminum, cerium, iron, and calcium. Found in Santa Barbara County.

Pectolite, silicate of aluminum, calcium, natrium. Found near Santa Barbara, and also in Tehama County.

Pharmacolite (monoclinic), arsenate of lime. The specimens are peculiar, in that they contain calcite and baryta with pharmacolite in caves, and are covered more or less by erythrite. Veins of smaltite run through the rock, and there are also various black spots composed of sulphide of silver and arsenate of cobalt, in which may be seen free native silver, a combination not before found in California, and we have no information that it has ever been found in any other quarter. The samples were found in the O. K. Mine, San Gabriel Mining District, Los Angeles County, and were presented to the Mining Bureau by Mr. W. Evans, on June 25, 1889.

Phosphate of Lime. Found in Fresno County.

Prochlorite, hexagonal cleavage, silicate of iron, aluminum, and magnesia. Found in the Gold Bank Mine, with free gold and trace of silver, Forbestown, Butte County.

Pyromorphite, phosphate of lead. Found in the Rocky Glen Mine, Nevada County.

Pyrrlotite, magnetic pyrites. From the Yuba Mine, Washington District, Nevada County.

Realgar, red sulphate of arsenic. Found in San Bernardino and in the northwestern part of Trinity Counties.

Rhodocromite, rhodophyllite, silicate of aluminum, chromium, iron, and magnesium. Found in Monterey, San Luis Obispo, Nevada, and Amador Counties.

Smaltite, gray cobalt ore, arsenide of cobalt. Found in Lassen and in Los Angeles Counties.

Smithsonite, carbonate of zinc. Found in St. Ygnacio Mine and Union Mine in Inyo County and San Bernardino County.

Spinel, silicate of aluminum, iron, magnesium, and calcium. Found at Gold Bluff, Humboldt County.

Stromerite, sulphate of silver and copper. Found in Cerro Gordo, Inyo County.

Tantalite, columbate of iron. Found in Calaveras County, near Milton.

Tiemannite, selenide of mercury. Found in Lake County, near Clear Lake.

Titanite, silicate of titanate of calcium. Found in granite at St. Johns Quarry, San Bernardino County.

Topazolite, variety of garnet. Found in Tulare County.

Tourmaline, silicate of boron, alumina, iron, magnesia, and sodium. Found in San Diego County as rubellite, but black in Plumas, Inyo, and Tulare Counties.

Willemite, siliceous oxide of zinc. Found in the mines of Inyo County.

Wollastonite, tabular spar, silicate of lime. Found in Lake County, near Glenbrook.

Zinc (native). Found near Cow Creek, Shasta County.

SANTA CLARA COUNTY.

By A. H. Weber, *Assistant in the Field.*

One of the earliest settlements made by the padres in Central California was located in the chief valley of this county.

The political boundaries need scarcely be repeated here, but it might be of interest to note the natural objects forming the boundaries of this flourishing county. On the northwest and north the line follows the course of the San Francisquito Creek to the bay, thence easterly along the center of Coyote Slough to the Lone Tree Creek; up this creek and then directly east to the watershed between the San Joaquin Valley and region of San Francisco Bay.

On the east the boundary between Santa Clara and Stanislaus and Merced Counties follows the devious line of this watershed to a point at the southern headwaters of the San Felipe Creek, a tributary of the Pajaro River. The line then strikes due west across country until it strikes the Pajaro River, and continues down this stream to a point a short distance below Sargent's. The boundary on the west has a general northwest and southeast course, following the watershed of the Santa Cruz Mountains, beginning at the north at the head of the San Francisquito Creek, and thence southeasterly along the mountain tops till it finally reaches the point below Sargent's on the Pajaro River before mentioned.

Topographically the chief feature of the county is the great central valley, hemmed in on the east and on the west by mountain chains forming part of the Coast Range. The Santa Clara Valley and its southern continuation, the Gilroy Valley, is but a part of the great depression, occupied to the north by the Bay of San Francisco.

These ranges of hills and mountains are by no means as simple as the above words might indicate, but on the east as well as on the west of this valley they consist of a series of parallel ridges, occasionally cut through by the various streams. Between these various ridges smaller but exceedingly fertile valleys are located. Among such might be mentioned Hall's, San Gabriel, Calaveras, San Antonio, Los Animos, and numerous smaller ones.

The ranges of mountains to the east of the Santa Clara Valley gradually rise higher and higher until they culminate in Mount Hamilton, four thousand two hundred and nine feet in height. Red Mountain, a conspicuous landmark on the watershed forming the eastern boundary of the county, does not reach this height by several hundred feet.

On the west the mountains rise more abruptly, though likewise flanked by several lower ridges.

Such peaks as Mount Chonal, Loma Prieta, Umunhum, etc., form the culminations of the Santa Cruz Range.

It might be well to state here that the Santa Cruz Mountains consist of quite a number of parallel ridges to the west of the watershed in Santa Cruz County.

There are not many streams in the county. Chief among them is the Coyote Creek, rising near the eastern boundary in the center of the county; thence it flows southerly until it breaks through one range of hills just south of Gilroy Hot Springs; then it turns northerly until near Madrone Station, where it again cuts its way through a range of hills and enters the main Santa Clara Valley and flows north past San José to the bay.

The Los Gatos Creek, the Guadaloupe, San Juan Cupertino Creek, and other smaller ones, drain the western and northern part of the county.

In the northeastern part the work is performed by the Arroyo Honde, with its branches, Smith's Creek and Ysabel Creek, the Arroyo Bayo and the Alameda Creek, all branches of the Alameda Creek, and entering the bay below Niles.

The Pajaro River and its branches, the Uvas Creek, the Arroyo de las Llagas, the San Felipe Creek, carry off the surplus water from the southern part of the county.

One specially characteristic feature of the ridges formed and developed by these streams, is, that while traveling southward through the Santa Clara Valley, the several ranges successively form the boundary of the valley. From a few low knolls the hills gradually rise higher and higher, until they finally form a continuous ridge, only to be supplanted by another further on.

This feature is more distinctly noticeable on the eastern than on the western side of the valley. It is due to the general trend of the entire Coast Range from northwest to southeast, so that in going south the successive component ridges of the Coast Range are either crossed or their heads passed.

The geological formations found within the limits of the county are the cretaceous, tertiary, and quaternary, or recent.

The delineation of these several formations and their accurate plotting will be the work of years of unceasing labor. It has already been commenced by the United States Geological Survey, as shown by their recent publication of Monograph XIII: "The Geology of the Quicksilver Deposits of the Pacific Coast," by Geo. F. Becker.

The recent or quaternary formation is made up of beds composed of the detritus of all the other strata, and fills the valley bottom. The beds, if such they can be called, are of various composition, clay, blue or yellow, sand, gravel, varying from the coarsest to the finest, according to the distances it has been transported.

One characteristic feature of the recent formations on the eastern side of the Santa Clara Valley is the frequent occurrence of pieces of volcanic scoria. These consist of basalt, but with as many cavities and the intervening walls so thin that the pieces readily float on the water, and are thus carried into the valley by every freshet. They will be mentioned again later on.

While the quaternary is thus necessarily confined to the valleys, leaving the remaining territory to the other formations mentioned above, the separation of the cretaceous and tertiary beds is complicated and rendered a difficult problem to solve on account of the dense growth of chaparral, covering many a hillside with an impenetrable tangle, rendering exploration almost impossible. Further, by the scarcity of fossils to identify the strata when these are exposed; and last, but not least, by the intense and complete alteration many of the strata have undergone in the process of metamorphism. A large number of instances of such metamorphism are discussed in detail by Prof. Geo. F. Becker, in his publication mentioned above, and to which the reader must be referred.

In regard to the areas occupied by and the general distribution of such areas of metamorphic rocks, they at first sight seem to be very irregularly distributed over the country, but when taking into account the various degrees of metamorphism, from the masses of serpentine representing, for example, the fully altered strata, to the slightly changed sandstone, exhibiting such change only to the closest inspection, one cannot help being struck by certain alternations of such highly altered and unchanged or but slightly altered strata. Thus, for example: Going east from Perry's Station, on the Southern Pacific Railroad, after crossing the Coyote Creek, a low ridge of rounded hills is first reached scarcely two hundred feet in height, and consisting of beds of clay, clayey sand, and gravel. Their components being soft and easily eroded material their rounded form follows by necessity. Closely abutting against this low ridge is a long continuous high ridge of greatly altered strata, consisting mostly of serpentine and rising to a height of nine hundred to one thousand feet. So closely does the low ridge first mentioned lie against the higher one, that at first sight and even on casual examination the low hills seem but spurs of the high ridge. This impression is still further strengthened by the large amount of detritus that has been washed down from the higher ridge, filling the gullies, and also by the lack of exposures of the strata composing the low ridge by reason of the softer material.

A closer examination at once reveals the great difference between the two ridges—the lower consisting of strata unaltered, or nearly so, while the higher consists mainly of serpentine and similar highly altered rocks. At two points gullies had been cut by the winter rains deep enough to show the relation between the strata forming the two ridges. At one the serpentine had a dip of about 25 degrees to the west, while the clay beds forming part of the low ridge were horizontal or with a slight easterly dip. At the other the same general relation was perceptible, though the actual contact was not exposed.

Continuing eastward over the high ridge the Los Animos is next crossed; then comes a lower ridge of considerable extent, composed of but slightly altered material, again producing round hills. Then follows the high Pine Ridge, made up of more highly changed strata. Further east the differences are not so pronounced. There seems to be a great probability that the differences between the successive ridges may be caused by the changes produced by the folding of the strata in the general upheaval or formation of the Coast Range. Thus that the portion of the strata forming a syncline by the folding should be compressed and more highly altered than another part forming the anticline.

An interesting section is exposed along the Penetencia Creek, showing the ridge to consist not of a similar fold but of a series of intricate and complicated minor folds. Very similar sections can be seen along the Mount Hamilton road and the road along Los Gatos Creek.

As stated before, a full discussion of the details of metamorphism in the Coast Range can be found in the monograph cited above.

Gradual chemical change, such as we call metamorphism, would presuppose the presence of water absorbed in the pores of the rock. An interesting example to this point occurs at the Boca del Coyote, east of Madrone Station. Here a basalt dike has broken through, running northeast and southwest. The rocks near the basalt were altered by the heat, that is they have lost the capacity of absorbing water to a great extent. These still show their former structure with but slight changes, while the rocks farther away that were unaffected by the heat have been completely changed.

Not alone do the many complicated folds of the strata render their recognition and determination difficult, but a series of cross-faults has further so broken up the already contorted strata that the tracing of the continuity of the several beds becomes exceedingly perplexing.

The Goodrich and Stanford quarries afford excellent examples of this cross-faulting, much to the regret of the owners working them. Again, the quarries of the Guadaloupe Lime Company expose not alone a number of faults, but likewise a very interesting series of intricate folds; these are rendered more pronounced by the thin dark interstratified seams of siliceous rock.

To the west of San José, north of Congress Springs, a section might be described somewhat similar to the one given in detail above when traveling from Perry's Station eastward. Here we also find a lower outlying ridge composed of almost unaltered strata, followed to the westward by a high range of altered rocks. The blue shale found in these lower hills contains a few fossils. The material readily softens in water, and is scarcely more than consolidated blue, clayey mud, such as is plentifully found along the bay shore at present. Its shiny appearance, especially when rubbed, has repeatedly led people to imagine that it was coal. Here are also heavy beds of gravel accompanying the clay beds.

The low ridge described east of Perry's Station, as well as the one just mentioned, plainly show the cross-faulting spoken of above. Along the western side of Santa Clara Valley there seems to exist a fault which has caused the strata forming the bed of the valley to have a decided dip to the west. The reason this is especially mentioned here is the following: From the Laguna Seca on the south to the Willows, in San José, there are a series of small swamps (some during the entire year, others only in winter and spring) that form natural storage reservoirs. One of these, about three miles south of town, has just been drained by the city and county jointly.

At several places spurs from the range of hills on the western side run into the valley across this line of swamps, thus increasing the storage capacity of those above them.

From San José south there is a continuous rise in the valley from eighty feet at San José to nearly three hundred at Madrone Station.

The largest and most extensive of these swamps is the Laguna Seca, about fourteen miles south of San José, and, approximately, two hundred feet above the city. Mr. Polhemus, who owns a large ranch just south of the Laguna Seca, has sunk a large well (about ten feet square) through nineteen feet of soil and clay into a gravel bed, ascertained by boring to be about forty-five feet deep, and underlaid by clay. The amount of water obtained from this well is very large. A centrifugal pump of the largest size, running continuously at full speed, is unable to exhaust the water, but leaves fully four feet out of the ten feet usually in the well. In case this source of water is thoroughly exploited and developed, it may in time become one of the chief water supplies of the City of San José. The elevation is sufficient, and there seems to be a plentiful supply of water.

The great number of wells that have been bored in the valley have amply demonstrated the existence of a number of beds of gravel yielding copious flows of water. From San José northward to Alviso, most of these wells are artesian, that is, they overflow. This shows that the source of the water lies on higher ground further south.

The occurrence of basalt in the neighborhood of Madrone Station is as follows: A small dike runs through the hill on which Mr. Polhemus' residence is built; another has cut through the high ridge on the eastern side of the valley, about one mile north of the Coyote Creek, in a northeast and southwest direction. Basalt is likewise found at Murphy's Peak, southwest of Madrone Station.

It is an interesting fact that just here is found the watershed, sending the waters northward to the Bay of San Francisco on the one side, and southward to the Pajaro River and thence into the Bay of Monterey on the other side. The connection between the two seems pertinent, but whether the eruption of the basalt was the cause of the formation of the watershed, or whether, rather, the basalt was the result of an upheaval in this section, it is difficult to say. That such a force existed is attested by the numerous cross-faults found in many localities. This force acted in a general north and south direction, while originally the ranges were formed by forces acting east and west.

Another item which might be construed as favorable to the latter view is that just at this point the Coyote Creek has cut its way through the otherwise unbroken high ridge on the eastern side of the valley. The upheaval, however caused, produced a weakness in the continuity of the strata, thus affording erosion an excellent opportunity to cut across the ridge.

At this dike, just to the north of the Coyote Creek, a large quantity of the basaltic scoriæ, mentioned before as occurring along the course of the creek in the valley soil, are found with the basalt bowlders of the dike. Many of them are red, or reddish brown, from oxide of iron, resulting from the disintegration of the scoriæ. Large masses of the basalt forming the outcrop of the basalt show the characteristic columnar structure.

This basalt is located but two or two and one half miles from the railroad, easily accessible by a road. It is dense and hard, and cuts very fairly. It is an excellent material for paving blocks and should receive early attention, from its proximity to the railroad. Basalt likewise occurs on the upper course of Coyote Creek.

The mining industries of the county have not changed to any material extent during the past year, except in so far as the work of development at the several mines has progressed.

The agricultural interests in their many branches have monopolized the public attention to such an extent that the mineral resources of the county have been overlooked.

The first mine developed in the county was the New Almaden Quicksilver Mine. Its history has been written so often and in such detail that it is scarcely necessary to repeat it here. In addition the monograph already cited gives a detailed description of the mine and the full geology of the vicinity. During the past year the work of exploiting has been steadily pushed, though with but indifferent success in regard to the development of any large bodies of ore, and consequently the production of quicksilver has fallen below that of previous years.

The Guadaloupe Mining Company has not made any move during the past year toward the reopening of its mine. Considerable prospecting for cinnabar has been done on the eastern side of the valley along Silver Creek and adjacent streams. The prospects seem fair, but up to the present nothing of note has been found or at least become publicly known.

The Guadaloupe Lime Company has continued its operations during the past year, producing fully three hundred barrels of lime per month. A full description of their lime kiln was given in the eighth annual report of the State Mineralogist, pages 543 to 545. The quarries, as developed at present, show several grades in the limestone, varying from a black bituminous to a grayish white. One special feature of the lime has been noted and complained of by the parties using the same, that is, the quick setting of the lime when made up as mortar. This is rather a property of cement than of lime, and indicates the presence of silicates in the lime. A close examination of the quarries reveals that the limestone is interstratified with narrow bands of chert often dark colored, and then easily separated by hand, but the limestone itself is often dark or the chert light in color, thus rendering the segregation of the chert well nigh impossible, and it thus finds its way into the kiln.

The silica thus introduced into the kiln with the lime fully accounts for the property of quick setting noticed and objected to by the consumers.

These bands of dark colored chert emphasize the intricate plications of the foldings to which the strata have been subjected, very similar to those exposed along the Penetencia Creek mentioned before. These plications render the work of quarrying the limestone more difficult and expensive on account of the large amount of surface and soil and waste material that it becomes necessary to remove.

Possibly the manufacture of cement might be advantageously commenced at this place, as the lime already has some of the properties of cement, and further materials necessary for the manufacture can be found near at hand.

The lime kiln near Los Gatos was in operation for awhile during the past year, and the local market supplied. At these limestone quarries they likewise have to contend with the interstratified chert, rendering hand picking necessary, and thus increasing the cost of production.

A good outcrop of light colored limestone is found to the north of the Azule Spring, several miles north of Saratoga.

Another very promising outcrop of limestone of good quality occurs to the northeast of the Goodrich Quarries. On the eastern side near the top of the ridge the limestone shows in considerable quantity. The locality is certainly a promising one, inasmuch as good roads are on both sides of the ridge; likewise railroads, the Almaden branch being on the west, while on the east the main line of the Southern Pacific is less than two miles away. The establishment of a lime kiln here would depend mainly on the supply of cheap fuel and upon the uniformity of the limestone and its freedom from chert. The latter condition cannot be answered without a more thorough examination of the magnitude of the deposit by means of small quarries or cuts.

BUILDING STONE.

The same quarries that were reported in operation a year ago have continued and extended their works according to the demand of the trade.

The quarries are located about seven or eight miles south southeast of San José, in the same range of hills in which the limestone just mentioned is likewise found. These quarries have been fully described in the eighth annual report, page 547.

The Goodrich Quarry is furthest south of all, about four hundred yards from the railroad (the Almaden branch of the Southern Pacific Railroad), at the mouth of a small ravine. One of those cross-faults mentioned before runs through the middle of the quarry as now opened. To the south of the fault the beds have a dip of fully 30 degrees to the north, while on the other side they incline but 10 to 15 degrees northeast. As at present exposed and worked the beds show the following thickness:

South of the fault from the bottom—

First ledge, eight and one half to nine feet thick.
Second ledge, five feet thick.
Third ledge, eight feet thick.
Fourth ledge, eight to nine feet thick.
Fifth ledge, twelve feet thick.
Sixth ledge, seven to eight feet thick.
Seventh ledge, nine feet thick.

The seams between the several ledges are all well defined, and carry more or less clay, especially between the fourth and fifth ledges. The clay averages fully two inches in thickness, greatly facilitating the working of the heavy top ledge (fifth, twelve feet thick). The seventh ledge, or top, is naturally much broken, being at the surface; but the others show very few fissures. Along the line of the fault all the beds are, of course, much broken. To the north of the fault six beds are exposed; their thickness is as follows, likewise beginning at the bottom:

First ledge, nine feet thick.
Second ledge, nine feet thick.
Third ledge, four feet thick.
Fourth ledge, one foot thick.
Fifth ledge, one foot thick.
Sixth ledge, ten feet thick.

The two nine-foot beds afford excellent material, while the three ledges at the surface (ten feet, one foot, one foot, respectively) are so much broken up that nearly all has to go to the dump.

There are other smaller openings around, from which blocks of stone have been taken occasionally, but the main work is concentrated on the quarry described above.

The beds near the surface are harder (from exposure) and somewhat finer grained than those below.

The Stanford Quarries lie about half a mile to the north of the Goodrich Quarries, close to the railroad. They take their name from Governor Stanford, who has leased them from Mr. Goodrich to procure building material for the Stanford University, at Palo Alto. Fully one hundred feet vertical are exposed in these quarries. The beds are usually very thick (ten, fifteen, and twenty feet). They have a dip of about 20 degrees to the northeast. The seams separating the beds carry so little clay that, at first sight, the whole face exposed appears to be one solid bed; only on close inspection can the seams be made out and traced. On the contrary, the fissures, quite numerous here, carry considerable clay, so that the stone, instead of coming out in more or less regular blocks, is obtained in large irregularly shaped masses, entailing considerable loss of material and time needed to shape them.

The Flynn Quarry lies about one mile nearer San José, likewise close to the same railroad. The material is of the same quality as in the other quarries, and the beds are easily worked. This quarry has not been opened as largely as the others.

PETROLEUM.

Moody Gulch, five miles west of Los Gatos, in the Santa Cruz Mountains, is the only oil-producing locality in the county. Full descriptions of this locality have been given in the seventh and eighth annual reports of the State Mineralogist.

The Pyler Well, sunk a year ago, and described in the last report, has been abandoned after reaching a depth of over fourteen hundred feet, on account of the tools getting stuck and defying every effort to remove them.

During the past year, Well No. 9 has been sunk to a depth of sixteen hundred feet. At a little over eight hundred feet the oil-bearing sand was reached, from which the other wells still yielding derive their oil. At sixteen hundred feet "shell" rock was struck again with traces of oil. This "shell" rock is a very hard, dense quartzose shale usually overlying the oil-bearing sands in this district. During the present autumn, Well No. 10 has been started in the gulch.

ASPHALTUM.

The asphaltum deposits near Sargent Station, on the land of Mr. J. Sargent, have again received attention late this year, several carloads of the material having been taken out and shipped to San Francisco, probably to use as bituminous pavement.

COAL.

Coal has been reported from several localities in the county. One near Alma showed nothing but small fragments distributed through a soft sandstone. Another near Wright's Station proved to be a bed of black shale.

The coal found on Stevens Creek, and on the divide between Azule Spring and Stevens Creek, proved to be, as far as it could be examined, black shale.

Coal is likewise reported from Ysabel Creek, north of Mount Hamilton.

A deposit of plumbago has been found on Mr. Hubbard's ranch, on the eastern side of Ysabel Valley.

NATURAL GAS.

Natural gas has been found in small quantities in a number of localities in the county, particularly to the west of San José, in the Santa Cruz Mountains.

At Moody Gulch some gas is usually struck when boring the oil wells, at times sufficient to keep up steam. The occurrence of gas when piercing the tunnels of the narrow gauge railroad is well known. At several other spots in the neighborhood of Los Gatos traces of gas have at times been reported.

Although hundreds of artesian wells have been sunk in the vicinity of San José, many reaching a depth of one thousand feet, yet the failure to strike natural gas in any of them cannot be considered as absolute proof of its non-occurrence in the valley, but is only conclusive to the depth reached by these wells, and does not preclude the finding of gas at a greater depth of two thousand or three thousand feet.

GOLD AND SILVER.

Gold and silver finds have been reported from various parts of the county. These were mostly mentioned in the eighth annual report, but several have been reported since then. Several small pieces of gold quartz were picked up in the bed of the Llagas Creek by Mr. A. T. Herrman. On further search nothing more was found in the creek. Gold quartz carrying a few dollars in gold and silver has been found on Red Mountain, east of the San Anton Valley.

MANGANESE.

Manganese ore, aside from the well known huge bowlder at the mouth of the Penetencia Creek, also occurs on the north fork of the Penetencia Creek, about ten miles northeast from San José. This locality has been opened and some ore shipped, but the transportation into San José was found to be too expensive to make the enterprise a paying one.

COPPER.

Copper ore was found on the Hahn ranch and the mine worked many years ago. Likewise some poor sulphuret ore was found and worked by a tunnel near Lexington. Recently a fair prospect of copper ore, chiefly chrysocolla and malachite, has been found on the Laguna Seca ranch, about seventeen miles southeast of San José and about three miles from Madrone Station.

CHROMITE.

Chromite has been found in a number of places in the county. The occurrence on the Hahn ranch was described in the last report. Since then a small pocket was found about half a mile south of Lexington.

On the high ridge on the east side of the valley, between Coyote and Madrone Stations, chromite has been repeatedly found as float pieces; recently several smaller pockets were found yielding excellent ore, but thorough prospecting will no doubt reveal larger quantities of the ore.

MAGNESITE.

This is quite a common mineral throughout the county, especially to the east and southeast of San José. The mineral occurs in the shape of small nodules in and near serpentine. The principal occurrence of the mineral is about three miles east of Madrone Station, not far from the Coyote Creek. This locality is well known, and the main reason for calling attention to the same is the interests these deposits present geologically.

A close examination of the magnesite, particularly the poorer quality, reveals traces of the surrounding country rock, greenstones, and shales, showing that the mineral was not deposited in a vein or bed, but rather as large irregular masses, gradually replacing the country rock. As a phase of metamorphism this process is still continuing in a large number of places, not only in this locality, but over a large area, however only on a very small scale.

How were there such large masses of rock transformed into magnesite in a manner as to present solid masses of the mineral? They were beyond question formed by carbonate springs, such as abound throughout the county. The country rock, chiefly magnesian silicates, was decomposed, the magnesia transformed into magnesite and left in place while the silica was deposited in the shape of quartz or chalcedony veinlets close by.

It is quite possible that these springs were hot, or at least warm, as the basalt dike, spoken of before, is close at hand. Moreover, there is not one but there are several deposits in this immediate neighborhood, at least three or four. Only the one on the east side of the ridge has been opened, showing fully one hundred tons in sight.

Several brickyards are utilizing the clay beds found in the Santa Clara Valley. There are two just south of San José, which, together with the extensive one on the narrow gauge railroad between San José and Campbell, supply not only the local demand but also ship to San Francisco. Another brickyard is at Mountain View.

The only pottery established in the county is Steiger's pottery, between San José and Santa Clara. Some clay from Ione is introduced to mix with the local material which does not have quite the proper composition. The articles produced are chiefly sewer pipes, flower pots, etc.

SAN NICOLAS ISLAND.

By Dr. Stephen Bowers, Assistant in the Field.

San Nicolas Island belongs to Ventura County. It is nearly eighty miles south of the town of Ventura, the southeastern end being in latitude 33 degrees 14 minutes north, and longitude 119 degrees 25 minutes west from Greenwich.

The area is about nine miles long and four miles wide, containing 32.2 square miles, or twenty thousand six hundred and eight acres. Its longer axis is northwest by west.

What is known as Begg Rock is situated on the prolongation of the longer axis of the island, bearing northwest, and is seven miles distant. Soundings show that there is a submarine ridge connecting this rock with San Nicolas, and that it was probably once above the surface, but has been worn away by the action of the waves. Breakers extend for several miles to the westward, and also for nearly two miles on the eastern shore line of the island, indicating shallow water.

Begg Rock is bold and precipitous, rising to the height of forty or more feet, and plainly visible from San Nicolas.

There is an abundance of water on the island, but it is slightly brackish.

San Nicolas is entirely destitute of timber, but evidently has not always been so. At the present time there is not even a bush growing on it except a stunted kind of thorn, scarcely two feet high, and a few species of the tree cactus.

The surface is comparatively level, sufficiently so to till with little trouble. This cultivable land embraces about two thirds of the island's area, and much of it is apparently rich and fertile.

GEOLOGY OF THE ISLAND.

The underlying rocks are composed of sandstone, with calcite, dipping to the north. The calcite, which occurs in seams, varies from almost microscopic fineness to two or three inches in thickness, and often affords beautiful crystals. The angle of inclination of the rocks on the northern side is 15 degrees, and on the southern side about 13 degrees. Coral Harbor, located about three miles from the extreme western point, is reached by an opening in the rocks some twenty feet wide. The water in this opening is sufficiently deep to admit a schooner of twenty tons burden. Inside is a quiet little bay about sixty-five yards in diameter, now filling with sand drifting from the land; in a few years it will probably be entirely obliterated. From this point the rocks are exposed east and west for two or three miles along the shore, and extend some distance oceanward, forming a barrier against which the waves constantly beat. Here, as elsewhere along the shore-line of the island, the coarse sandrock is worn into fantastic forms.

In one place may be seen a portion of it rising to the height of eight or ten feet, presenting an appearance of the neck, breast, and body of an immense bird, forty feet long, with a hooded head, and as perfect in many respects as if fashioned by the hand of man.

Going westward from Coral Harbor, the rocks lose their angle of inclination, and become almost horizontal.

In most places I observed that the rocks along the immediate shore-line dip toward the ocean. The island presents the appearance of having been gradually emerged from the water, the force acting uniformly throughout every portion at the same time, and leaving the strata intact. East of Coral Harbor, about half a mile from the ocean, is an exposure of rock presenting a columnar structure.

I occasionally picked up fragments of mortars and pestles which had been manufactured from vesicular basalt, but I have reason to believe the material had been brought from the main land. It is the same in character as that found on the Conejo plateau.

Fragments of serpentine, obsidian, and soapstone were frequently found in the shell heaps and Indian rancherias, but like the basalt, they doubtless came from the same source, as I could find none *in situ* on the island. As stated above, the country rock is sandstone, some of which contains fossils. A thin stratum of comminuted or powdered shells occurs in the sandstone at Coral Harbor, but they cannot be easily identified.

About one mile east of this is found a bed of pliocene fossils extending along a barranca (a deep break, worn by mountain floods or heavy rains), from the ocean to near the center of the island. In one place in this ravine I observed the following forms:

Acmæa mitra, Esch.
Acmæa patina, Esch.
Acmæa pelta, Esch.
Acmæa spectrum, Nutt.
Acmæa scabra, Nutt.
Acmæa persona, Esch.
Arionta gabbi, Newc.
Amphissa corrugata, Roe.
Bittium asparum, Leach.
Crepidula adunca, Sby.
Chlorostoma brunneum, Phil.
Chama exogyra, Con.
Chlorostoma pfeifferi, Roe.
Calliostoma annulatum, Mart.
Chlorostoma funebrale, Ad.
Crepidula dorsata, Brood.
Cumingia californica, Con.
Drillia inermis, Hds.
Euparypha tryoni, Newc.
Fissurella volcano, Roe.
Glyphis aspera, Esch.
Gadinia radiata, J. G. Cooper.
Haliotis cracherodii, Leach.
Hipponyx antiquatus, Lin.
Lottia gigantea, Gray.
Lacuna solidula, Mont.
Lazaria subquadrata, Carp.
Lunatia benisii, Gld.
Lucina californica, Con.
Mitra maura, Roe.
Muricidea subangulata, Stearns.
Pomaulax undosus, Wood.
Petricola carditoides, Con.
Stenoradsia magdalensis, Roe.
Strongylocentrotus drobachiensis.
Serpulorbis squamigerus, Carp.
Septifer bifurcatus, Roe.
Tapes staminea, var. ruderata, Con.
Tapes staminea, Con.

Nearly all round the island the shore-line is steep and about fifty feet high, from which the ground gradually rises in a sort of mesa or table land, say one hundred to five hundred yards wide, and terminates in a steep escarpment, which reaches an altitude of from five hundred to eight hundred feet. The high land is about seven by three miles in extent, and sufficiently level to till. Much of it contains what appears to be good soil, and ought to yield abundant crops if brought under cultivation. There are but few exposures of rocks on the elevated portion of the island excepting near the upper termination of the escarpment mentioned, where they have been denuded by wind and rain. In a few places the sandstone is capped with limestone bleached to chalky whiteness. Patches of small waterworn bowlders and pebbles of quartzite, porphyry, etc., are occasionally met with on the table land. The escarpment is most abrupt on the south side of the island, and in some cases is washed into picturesque cañons. The western end of the island is exposed to westerly winds, which often blow for many days without intermission; as a result one meets with many sand-dunes, with an occasional outcropping of shell heaps which have resisted the wind's force. In many places may be seen impressions or casts of roots of trees, ranging in size from coarse fibers to several inches in diameter. The loose soil and sand have been blown from around them, leaving the casts of semi-petrifactions intact. They are so hard as to sound metallic when thrown on the ground or when struck with a hard substance. In other places thousands of columns of indurated sand, ranging in height from a few inches to several feet, may be seen. At a distance they look like stumps of small trees. It is probable that at some period the island suffered from drought, causing the ground to crack, and these fissures have filled with drifting sand which, becoming compact, remained in upright columns, while the soil around them has been blown away.

ITS ZOÖLOGY.

The only animals found on San Nicolas are a small fox, a kangaroo mouse, and a diminutive sand lizard. One specimen of the last was seen. The fox is little more than half as large as the gray or silver fox of the mainland. As far as I have been able to learn, the species is confined to the Channel Islands. On this island it is very wild, and only seen occasionally, while on Santa Rosa it is noted for its absence of fear, not caring to move very far out of one's way. I judge that but few of these animals are now left on this island, as only three or four were seen by our party. This fox is named by Professor Baird Vulpus (urocyon) littoralis. Scarcely more than half the size of the gray fox (Vulpus virginianus); tail one third the length of body; above, hoary and black; sides of neck, fore legs, and lower part of sides, dull cinnamon; chin and sides of muzzle, black; tail, with a concealed mane of stiff hairs, and with black stripe above.

Their skeletons are frequently met with in the shell heaps and Indian rancherias—especially the skulls. I only saw one specimen of the kangaroo mouse. Seals, sea-lions, and other varieties of phocæ are still found here, but in limited numbers. In this connection I may speak of the remains of two species of dogs found all over the island. One of them, which seems to have resembled the bull-terrier, is probably a distinct species, and, if I mistake not, was identified by Professor Baird. It was domesticated by the Indians, and found living here as late as 1853. In some places as many as half a dozen skeletons of these canines may be seen lying together, indicating that they had perished from exposure and starvation.

Several species of land birds are found. Amongst them may be mentioned the bald eagle, ground owl, raven, crow, and plover. Water fowl are abundant, and among them are gulls, pelicans, cormorants, sea pigeons, and others.

On one occasion a continuous flock of these birds flew past our tent for the space of about three hours. There were unnumbered thousands. Beetles, crickets, spiders, butterflies, house and other flies are met with, but no poisonous or noxious animals or insects.

A noticeable feature of this island is the vast number of dead land shells strewn over the surface. There are two species of the Helix (euparypha) tryoni and Helix (arionta) gabli, the former predominating.

They are almost as numerous as the grains of sand driven before the wind, but not a living specimen is to be found. When they flourished there was vegetation on the island sufficient to support them, and their large size and vast numbers indicate anything but the arid waste that the surface now presents.

Mr. Nidever speaks of a portion of the island covered forty years ago with trees, brush, and moss.

These land mollusks were collected and eaten by the Indians, as many conical piles in their rancherias would indicate.

San Nicolas Island must have once supported a large population. In whatever direction one turns he comes in contact with human skeletons, broken mortars, pestles, ollas, bone implements, ornaments, etc., and shell heaps.

The circular depressions showing where their houses once stood may still be seen in great numbers. On a projecting point near the ocean I counted forty of these depressions, but not a vestige remains of the material out of which their habitations were constructed. The shell heaps and rancherias extend over the greater portion of the island. The one upon which we pitched our tent is about six miles long, with only an occasional break. It extends around the western end of the island, averages a mile or more in width, and is of unknown depth. About one mile east of Coral Harbor is a break in the shell heaps nearly half a mile in width, after which the rancherias appear again and extend around the eastern end of the island.

The high land, or more central portion of the island, contain hundreds of these shell heaps, forming in many instances truncated eminences. One is astonished at the vast number of shells found in these heaps. Indeed, it is impossible to convey to the reader anything like an adequate conception of their number. Millions multiplied by millions would be but a beginning. The haliotis (a genus of the Gasteropods) probably predominates; but all kinds of mollusks that these waters afforded, with every species of fish which the natives could take with their rude hooks and spears, seals, sea-lions, sea-elephants, whales, sea-otters, aquatic birds, as well as the island fox, were used by them for food.

In very many places human skeletons may be seen. The wind has removed the covering of earth and sand and left them exposed. The bones of these skeletons are large, and their processes denote great physical development, while the facial angles of the skull indicate more than ordinary intelligence for Indians.

I judge that the natives of this island were physically and intellectually superior to those inhabiting the other islands and the mainland, where, in previous explorations, I have exhumed several thousands of skeletons.

Many of the skulls on San Nicolas resemble closely those of the Caucasian type.

The method of burial was similar to that of the other Indians in this section—with the knees drawn up against the breast and the bodies buried face downward. As artificers in bone, stone, and wood they were certainly in advance of their redskinned contemporaries. This is the only place where I found a barbed fish-spear and stone knives with wooden handles. The Indians also used bone needles, with eyes perforated at the larger end for the purpose of carrying thread or sinew. As very few arrowheads, or other implements suggesting hostilities were found on this island, the inhabitants could not have been a warlike race. They doubtless lived in comparative peace among themselves, and were too remote from the other Indians and the mainland to receive attacks from those quarters.

Fragments of boat-shaped vessels, carved from crystallized talc, serpentine, sandstone, bone, etc., as well as imitations of whales and fishes, show them to have been an imitative people; and they were probably sun worshipers, as were the Santa Rosa Islanders; there are also indications of Phallic adoration.

They made much use of serpentine, from which they carved pipes, cups, discs, and a variety of ornaments. Their bone implements consisted of needles, perforators, scrapers, chisels, and also long bones flattened at the end, probably used for removing haliotis and limpets from the rocks.

A noted relic found on this island is the perforated disc. These discs are from one inch to five inches in diameter, and usually made of sandstone and serpentine. In most instances the hole is drilled from both sides, and is much larger on the outside than at the center. In other cases, the perforation is of the same size all the way through. Some of these discs have been highly polished. There is a variety of opinions amongst archæologists as to the use of these discs. Without entering into a discussion of this subject, I would remark that an Indian, to whom I once exhibited one of them, informed me they were used in games, which I doubt not is correct. In many places, piles of small, black pebbles are found, numbering from fifty to more than one hundred. In some instances they are carefully packed in large haliotis shells, and carefully covered with the same. It is somewhat difficult to determine what they were used for, and just why black porphyritic pebbles were selected in preference to others. Many hundreds of conical piles of these pebbles are to be seen in marked contrast with the white sand.

Fragments of other relics are also found, but a description of them is worth a separate report.

The sloop Hattie, on her return for us, reached the island on the morning of November third. We immediately embarked, but the wind being contrary, it became necessary to tack eastwardly to Santa Barbara Island, which we reached about sundown. This is the smallest island of the group, measuring only about two miles of shore-line. But its basaltic walls rise to a height of five hundred feet, and are accessible only from one side. The top is covered with deep, rich soil. It is a favorite resort for seals and aquatic birds, which congregate here in vast numbers.

REFINING AND COINING OF THE PRECIOUS METALS.

By Sven Gumbinner.

Prior to the year 1858 the small yield of silver in the United States did not render it necessary for the recording of any statistics.

In the following three years, as compiled from the reports of the Director of the United States Mints, the amount of silver annually produced averaged fully $100,000. But, in the subsequent years, the production of silver increased rapidly, the record of recovery being for the year 1870, $16,000,000.

From the years 1860–1870 the total recorded amount of silver produced in the United States was about $85,000,000; 1870–1880, the production was $375,000,000. From 1870 and up to the present date, the United States heads the world's list in the production of gold and silver, and, although the Comstock Lode has rapidly decreased in its output of these precious metals since the year 1877, other States, principally Colorado, have increased to make up that deficiency. The total production of gold in the United States for the fiscal year ending June 30, 1889, was $31,440,778, showing a falling off of about $1,000,000 from the prior fiscal year. The total amount of silver produced for the last fiscal year was $38,278,964. The production of silver having so enormously increased, it naturally had the tendency of making its influence felt in the previous relative value of gold and silver.

It is a fact worthy of recording, that no satisfactory explanation can be arrived at of what has actually become of the enormous output of the precious metals, for it has been fully demonstrated that what is known of the world's possessions in gold is but equal to the last thirty years' production, and that of silver equal to the last seventy years' production. It might therefore be reasonably concluded, that as the production has increased, so has the use of the same in the arts, ornaments, and its circulation as coin.

Without a single exception, so far as known to the present date, all gold in nature contains more or less silver; nor has the same ever been found in its absolute pure state, that is, free from baser metals.

All California crude gold, gold bars, etc., received at the mints, that portion which is not gold and the alloy, silver, constitutes the so called base metals, of which there are generally from ten to twenty parts in one thousand, of antimony and lead, copper, iron, often bismuth, traces of platinum and palladium, and frequently a small percentage of iridium.

All gold bars received in San Francisco from the Pacific Coast are stamped with the gold fineness and value thereof by the assayers casting the same, the silver contained therein allowed for at the market rate.

California gold bullion generally contains, on an average, 12 per cent of silver in weight, while that of Australia has averaged but 5 per cent, though in the past few years silver in the Australian gold has materially increased.

Generally silver bullion, as recovered from their ores, are more or less auriferous. The silver produced from pyritic ore, such as contain antimony, arsenic, and copper, is often very rich in gold, the poorest being silver from lead ores. But, unlike gold, large quantities of silver have been extracted from the ores in which not a trace of gold could be detected, notably at White Pine, Nevada. The gold contained in the Comstock bullion has averaged fully one third its value, frequently as much as one half.

"Doré bars" is a term applied to such silver bars as contain gold, as well as being alloyed with a small percentage of base metals. These bars are generally in the form of rectangular, oblong bars of various sizes, from one thousand to one thousand five hundred ounces each, differing in the contents of silver from six hundred to nine hundred and ninety per thousand, the base present chiefly consisting of copper, lead, often antimony, and sometimes sulphur.

Silver bars are those which are free from gold, and sufficiently free from alloys to render them fit for coinage and for the use in the arts.

"Base bars" contain a large percentage of base alloys, usually comprising lead and antimony, or copper, differing in their contents in silver from one hundred to six hundred in one thousand, and often containing gold.

MELTING AND PRELIMINARY REFINING OF DEPOSITED BULLION.

At the mints deposits of every description are invariably remelted, as a necessary precaution to a uniform mixture that a correct sample for the assay may be obtained.

"Tough gold bars" and "fine silver bars" are received at the mints without being remelted. The same are chipped and the chips assayed to ascertain the correctness of the stamped fineness.

When the gold is received in dust, gold bars, or the spongy gold from amalgamation, etc., it has to be subjected to a series of metallurgical operations to obtain a state of purity sufficient for coinage or use in the arts.

The separation of gold and silver is mostly resorted to by means of sulphuric acid, which method is a very simple one, but it is frequently rendered difficult by too large an admixture of base metals, owing to the formation of salts from base alloys; hence, the necessity of preliminary refining in crucibles.

By this means there is obtained an alloy of gold and silver, sufficiently free from base metals and suitable for the separation of the gold from the silver.

Gold melts at 1,102 degrees C., and silver at 1,023 degrees C.

When gold is in a state of fusion, even in the strongest heat of a blast furnace it is not appreciably volatile; it proves, however, to be so in the heat of the oxyhydrogen jet, as a wire of gold placed therein soon disperses in vapor.

Silver volatilizes more readily when in a molten state, and rapidly so when in free contact with air.

The fusion of the deposits is performed in black lead crucibles, placed in the ordinary wind furnace, by means of a stone-coal fire. The deposits are placed in the crucible with a small amount of borax, which latter, besides taking up the earthy impurities, assists in the fusion of the metals.

When the deposit is melted, a small quantity of niter is added, which exerts a powerful oxidizing action on the base metals. If the deposit is very base the addition of niter is repeated several times, caution being taken to use but little at a time, as by too rapid an action the contents would overflow.

The molten mass is well stirred with a black lead spatula heated to bright red, which insures a perfect uniformity of the bar after casting, and immediately after the last stirring the crucible is lifted out of the furnace by means of a pair of long tongs, and the metal poured into a mold previously warmed and oiled.

It requires practice and dexterity to take the melting-pot from the furnace and cast the bar, so that there should be no spilling or chilling of the mass. The gold immediately sets in the mold, and the slag, consisting of the grosser impurities, accumulates on the surface.

The bar, while red, is turned out of the mold, the slag is removed from the metal, the bar immersed in the pickling vat, in which there is water acidulated with sulphuric acid, then dipped into clean water to remove the acid stain, the bar retaining warmth enough after removal to expel all moisture; after which it is cleansed of any adherent particles of slag, and hammered smooth. The bar is then chipped; that is, cuttings are taken from two diagonal corners, the chips are flattened, the rough edges of which are removed by shears, and these chips, or representatives of the melt, are assayed to ascertain the fineness of the bar.

The slags are ground finely in a mortar, or, as in the San Francisco Mint, under chili rollers, and vanned; the very small proportion of recovered grains are dried, weighed, and allowed for with the chips in computing the value of the assayed bar. This admirable system secures the depositor the full value of his gold. Naturally, in the metallurgical treatment of the precious metals, some loss is always sustained, but that incurred in the process above described is very rarely more than a mechanical loss of ten cents on a deposit of one hundred ounces.

The residual from the vannings is allowed to accumulate, and when sufficiently large, having been dried, is melted with a small addition of borax in an old black lead crucible at a high heat. The crucible and contents are allowed to remain in the furnace over night to cool. The crucible is then broken and the small particles of metal found adhering to the bottom are often principally silver from the action of the niter. It will be found that invariably the amount of gold recovered from these slags does not return sufficient to pay for fuel and labor involved.

Frequently the spongy gold obtained by amalgamation contains such a large quantity of iron that it is necessary to separate the latter from the former by sulphur. This sulphurization is effected in a plumbago crucible. The metal is kept at a melting heat, for when the temperature is too high the molten sulphur is wastefully volatilized. Into the molten metal sulphur is sprinkled near the sides of the crucible, because if the sulphur is thrown upon the center, particles of gold are projected to the sides and adhere thereto, and are very difficult to remove. The mass is carefully stirred with a black lead stirrer (previously heated to bright redness); the stirring is resorted to after each small addition of sulphur, the latter being added till the gold is entirely freed from its iron impurities. Sulphur, when intermixed with molten gold, has no action upon the latter, but upon the iron present it acts energetically, forming sulphide of iron; the sulphur also having a strong affinity for silver, takes up a small proportion thereof in the form of sulphide of silver, but not rapidly until nearly all of the iron has first been converted into sulphide.

The gold being now almost freed of iron, will subside to the bottom of the crucible. The crucible is now removed from the fire, gently tapped, and allowed to cool. When cold the mass is removed by inverting the crucible. It is then struck with a hammer; the gangue separates from the gold; the latter is then remelted and cast into a bar. This plan is superior to pouring the metal into a mold, because the lump of gold is better formed—is level on the top, and separates readily from the gangue.

When a large quantity of lead is present with the metal to be operated upon it frequently happens, owing, most likely, to the presence of basic sulphide of lead, that the niter employed acts but slowly in oxidizing the latter. By a free use of repeated additions of sub-ammoniac (chloride of ammonia), and alternate additions of niter, the lead will become more readily oxidized. Should any perceptible osm-iridium be present, the bar is remelted in a crucible clean of adherent flux. After melting it is kept at a high state of fusion for several minutes, the osm-iridium will settle, intermixed with the gold, in the bottom of the crucible. The crucible is then gently lifted out of the furnace and the greater portion carefully, but rapidly, poured into a mold. The remaining small portion of gold, now containing nearly all the osm-iridium, is allowed to cool in the crucible till it is set. It is then removed, chipped, and assayed separately, to determine the amount of osm-iridium. When sufficient quantities of these cones of gold with osm-iridium have accumulated to warrant the extraction of the osm-iridium, the following are the plans adopted:

To the gold with the osm-iridium, three parts of silver are added, melted, and again proceeded with, as in the first operation. The remaining silver and gold alloy, rich in osm-iridium, is several times melted with silver, whereby the osm-iridium becomes more and more concentrated with the silver and replacing to a great extent the original gold. After the last addition of silver the metal is granulated, the silver extracted by boiling concentrated sulphuric acid, and the separated gold washed out, leaving the osm-iridium. Or the gold containing the osm-iridium is dissolved by aqua regia, which does not attack the osm-iridium. The gold is afterward precipitated from its solution by sulphate of protoxide of iron, the residue well washed with boiling water, dried and fused with niter in a French clay crucible. Such osm-iridium is worth from $2 to $5 per ounce; pure iridium being worth about $20 per ounce; whereas selected grains of osm-iridium, suitable for pen points, are valued at from $50 to $70 per ounce, according to their size and quality. The osm-iridium grains are used for the points of gold pens called "diamond points." The latest discoveries have rendered the metal iridium available in the arts, many useful applications being made, such as "iridium bearings," made for fine assay scales and balances; iridium draw plates in place of ruby plates, hyperdermic needles for physicians and surgeons, which are made of gold and tipped with iridium in place of steel; and, also, for points of surveyors' and engineers' instruments.

Gold bars that are received at the mints and are of sufficient purity for the subsequent "parting" process are simply remelted without addition of any fluxes, stirred and cast into bars, chipped and assayed to determine their value.

In making a bar of cleaned skimmed metal it is necessary to throw a little powdered charcoal into the crucible before pouring into a mold, which insures a free flow of the metal from the crucible; it furthermore prevents spattering in pouring.

Gold bars received from the chlorination works are more or less brittle, therefore rendering this otherwise fine gold unfit for coinage, and this brittleness is generally ascribed to the presence of very small quantities of such metals as lead, antimony, arsenic, and bismuth, which metals have to be removed from the fine gold in order to render it "tough."

These kind of bars are remelted in black lead crucibles, in which no fluxing had been done. When in a state of fusion repeated additions of salammoniac is sprinkled on the metal, which exerts its influence on the lead principally, after which repeated additions are made of small quantities of powdered corrosive sublimate (bichloride of mercury). Care must be taken that upon the application of the latter the furnace door be at once closed, as dense and highly injurious fumes are immediately evolved. The corrosive sublimate is found to effect the complete toughening of the gold, by which the base metals are converted into volatile chlorides, and although the corrosive sublimate is only thrown on the surface of the molten gold (be there even two hundred to three hundred pounds of gold in a crucible), yet the whole mass is toughened by its action. When the gold is supposed to be toughened, a small portion of it is poured into a long, flat, iron mold. When set and cold it is folded back upon itself by hammering, and if not the slightest fracture is sustained the gold is considered tough; a little powdered charcoal is then sprinkled into the crucible, the mass well stirred, and poured into an iron mold. Silver bars are often very brittle, this condition being caused by the presence of antimony, arsenic, etc., rendering the silver unfit for coinage. In this case the bars are remelted with gold for subsequent parting.

A large amount of sulphur in silver bars renders the condition of the silver such that a correct assay cannot be had. The sulphur is reduced by introducing into the molten silver, with frequent stirring, wrought iron bars; the sulphur acting upon the metallic iron converts it into a sulphide, by which a complete desulphurization takes place; the metal is then skimmed, well stirred, and cast into bars. In the mints, all silver bars, excepting those which are the so termed fine silver bars, are remelted in black lead crucibles.

The metal, when fused, is kept constantly covered with charcoal, to prevent the too easily volatilization of the silver; it is diligently stirred with a black lead spatula; a sample is then taken from the metal by a plumbago dipper and poured into water; half of the contents of the crucible is then dipped out and poured into a mold, another sample is taken by the dipper, and the balance of the metal poured from the crucible into another mold.

The two representative samples are dried, assayed preliminarily by cupellation, and the exact value determined by the "humid" method. The bars are melted with gold bars for separation.

During the period of the free coinage of silver, or when a demand is created in the market for refined silver bars, which latter are principally sent to India and China, the heretofore mentioned auriferous silver bars, in place of being cast into bars again, were at some establishments cast into slabs for the direct separation by nitric or sulphuric acid, in place of being inquarted with gold and then granulated. These slabs were generally sixteen inches long, nine inches wide, and from three fourths to one inch in thickness.

The former method of using basket tongs, or the crane, for removing melts from the furnace, has been superseded by the following:

Two men grasp the crucible on opposite sides with tongs whose jaws are made to suit the thickness of the crucible. The crucible is quickly lifted high enough out of the furnace to allow the metal to be poured into the mold in front of them; taking, therefore, less time than even to adjust the basket tongs.

THE FEIX CHAMBERS FOR CONDENSING OXIDIZED METALS.

Mr. J. Feix, foreman of the gold and silver refining department of the branch mint at San Francisco, invented an ingenious flue dust chamber, which is used as an adjunct to the melting furnace, and undoubtedly saves all, or nearly all, of the metals volatilized, especially in those furnaces in which large quantities of silver are melted, as well as in melting ingots to be used for subsequent coinage.

Both the silver and the copper used for alloying become, under certain conditions, volatile, especially so when the molten metal is not protected by flues or charcoal dust; and volatilized copper generally carries a little gold or silver with it, and these are saved in the Feix chambers.

These chambers are built of brick directly back of the flue holes of the melting furnace. The bottoms of these chambers are about four inches lower than the flue holes; the sides project to a height of twelve feet, the width being about from nine to twelve inches; these dimensions are the inside measurements. The walls are two bricks in thickness; the top is covered with tiles, so as to admit of their ready removal. Flues from the chamber connect direct with the stack, entering the latter within a foot of the top of the chamber. Iron doors are firmly adjusted to the ends of the chamber, three at each end, through which the sweepings and dust can be drawn out. These sweepings are melted in an old plumbago crucible with borax at a high heat and left in the furnace to settle and cool, and the metal on breaking the crucible will be found as a regulus.

In the metallurgical treatment of the precious metals some loss is always sustained, which, when manipulatory skill is acquired, the proportional loss of gold and silver does not only decrease, but it is most surprising how very small the loss sustained becomes.

The precious metals having undergone the treatment as described, they are now in a condition for separation, called "parting."

PARTING BY NITRIC ACID.

This operation, upon which is based the thorough process now in practice, was first used in Venice in the early part of the fifteenth century by German assayers, who were in those days not inaptly termed "gold makers," they separating the gold from Spanish silver coin. The process was first extensively used in the Paris mint in the sixteenth century.

It is supposed that the art of refining was not fully practiced in England until about the middle of the eighteenth century.

The parting by the means of nitric acid is conducted on the large scale, on the same principle as the assaying of gold bullion.

GRANULATION OF THE ALLOYS.

The purified gold bars, and generally the "doré" bars, are prepared by adding the necessary alloy to the metal to be operated upon, the relation generally being one part of gold to three parts of silver, some establishments proportioning the quantities of one part of gold to two parts of silver. These proportioned metals are then melted together in large plumbago crucibles, and when in a state of fusion are stirred with a heavy iron rod. A thorough mixing of the metals is of the greatest importance, in order to admit of the dissolving of the silver from gold in the subsequent treatment. By a small plumbago dipper, previously heated to redness, the metal is dipped and poured into a copper tank filled with water, in which during the pouring of the metal a stream of cold water is constantly running. These copper tanks are about four feet high and two and one half feet in diameter. The metal is poured with a circular motion in a very thin stream, to prevent the formation of any lumps, by which means it is broken into leafy substances termed "granulations." Sometimes the crucible is hoisted out of the furnace by means of a clasp tongs or crane and tackling chain, and suspended about three feet above the water tank; the workman then tilts the crucible, pouring a thin stream, till the crucible is emptied of its contents. In the bottom of the tank there is a round copper pan, with handles, having a few perforations on one extremity, and capable of holding from four hundred to five hundred pounds of granulations. This pan with the granulations is then hoisted out of the tank by means of a crane and tackle and allowed to drain through the perforations of the pan.

DISSOLVING THE SILVER.

The dried granulations are next placed in white earthenware or porcelain vessels of cylindrical shape, about two and one half feet deep, two feet in diameter, widening at the top. Closely fitting earthernware covers are attached to these vessels, through each of which passes an earthenware tube as escapes for the nitrous fumes which are evolved when the nitric acid, which is poured in the jar, acts upon the granulations. The nitrous fumes are passed through a furnace of burning coke, where they are all or nearly all consumed; the nitrous oxide assists in the combustion of the fuel. These obnoxious fumes are allowed, in many metallurgical works, to escape directly through a chimney. No fumes escape in the room where the dissolving takes place, as the vessels are all inclosed in a lead-lined wooden hausing. Sliding doors of glass are attached opposite each vessel. The vessels are immersed in water, contained in lead-lined troughs, and the water is brought to a boiling point by steam conducted through pipes.

The charge of granulated metal is now gently boiled for about five to six hours with nitric acid of 38 degrees Baumé, which dissolves the greater part of the silver and base metals, requiring about two pounds of acid to one pound of the metal operated upon, depending, however, on the quality of the alloy, more acid being consumed if it contains much copper. The solution, after allowing sufficient time to elapse to subside and the gold to settle at the bottom of the vessel, is drawn off by means of a gold siphon into the chlorination vats. These vats are six feet deep, twelve feet square at the bottom, and nine feet at the top, made of wood two and one half inches in thickness. The nitrate solution is diluted with pure water to prevent the forming of crystals upon cooling.

PURIFYING THE GOLD.

The residue, now almost pure gold, is again subjected to boiling with strong nitric acid for about two hours, the solution siphoned off and added to the previously drawn solution, and finally the now remaining spongy gold is boiled once more for one to two hours with nitric acid.

This last solution, after being siphoned off, is separately put aside, and as it contains but very little nitrate of silver, is used again for the dissolving of the fresh granulations. The pulverent gold is washed in large earthenware dishes with boiling distilled water, being constantly kept in agitation, so as to remove all the nitrate of silver remaining, and as long as the washings show the least turpidity by addition of salt water. These washings are added to the first solutions, except such in the last stage, which are drawn into a large reservoir and treated with salt to precipitate the silver into chloride, to be subsequently separately treated and melted. The pulverent "sweetened" gold, which will be again referred to, is then pressed and melted. Either silver or gold is termed "sweet" when they are free from any impurities. It is claimed of this process, if care is exercised in every stage of procedure, that the subsequent gold bars will retain but three parts of silver in one thousand.

A SECOND METHOD OF DISSOLVING THE ALLOYS.

Another method of digesting the alloy is by nitric acid of 39 degrees Baumé, which generally dissolves the silver in four to five hours; distilled water is added to prevent crystallization, and the undissolved contents allowed to subside, after which the nitrate of silver solution is siphoned into the cholorination vats. The pulverent gold is washed from two to three times with distilled water, allowing the gold upon each washing to subside, and the washings are siphoned off into the chlorination vats.

PURIFYING THE GOLD WITH SULPHURIC ACID.

The gold is ladled from the earthenware jars into a wooden circular filtering tub, with a false, perforated bottom, upon which drilling is spread and the edges of the same closely tucked, so as to prevent the loss of any of the pulverent gold. Each tub is two feet in diameter and two feet deep. The washing with pure water is again resorted to until the gold is "sweetened;" *i. e.*, until every trace of nitrate of silver has disappeared. The gold is then introduced into castiron vertical cylindrical-shaped kettles, and digested for about five hours with concentrated sulphuric acid, thereby converting the silver and base metals that were still undissolved in the pulverent gold into sulphates; the contents are allowed to subside. The solution is then ladled off with an iron ladle into a lead-lined tank, the treatment of which is proceeded with as described under "parting by sulphuric acid." The gold is once more subjected to boiling concentrated sulphuric acid for a couple of hours; again allowed to subside, the acid ladled out, put aside, and used again for another operation for the first boiling. The pulverent gold is finally emptied into the wooden filters and washed with boiling water till sweetened; *i. e.*, that blue litmus paper, moistened with the washing, does not turn red. The acidulated water is run off through a plug-hole, below the false bottom of the filter, into a large reservoir, where the silver in the solution is precipitated by salt as a chloride. After settling, the clear solution is run off and these chlorides treated as hereafter described.

PRESSING AND DRYING THE GOLD.

After the spongy mass of gold has been drained (which following treatment is the case with all gold by parting in any of the humid processes) it is pressed in a hydraulic press, which exerts a pressure of about forty tons to the area of the plunger face, forming the gold into round cakes of twelve inches in diameter and from four to five inches thick. These are placed in round castiron pans, previously smeared with ashes moistened with salt water or pipe-clay, and conveyed to a drying furnace capable of holding one hundred to one hundred and twenty such cakes at a time, where they are slowly dried and heated to a cherry red. The cakes when cooled are broken into pieces of convenient size for the subsequent melting and casting into bars.

TREATMENT OF THE NITRATE SOLUTION.

The nitrate of silver solution in the chlorination vats is treated by addition of a strong solution of salt water in sufficient quantities to convert all the nitrate into chloride of silver. A constant agitation is kept up by means of revolving wooden agitators, resembling the agitator of a silver mill, which are run by steam power. The whole is allowed to settle, generally over night, the clear solution (now nitrate of soda) is drawn off through faucets and filtered, thence conveyed into the large reservoir mentioned before. The precipitated chloride of silver is washed several times with hot water under repeated agitation, the supernatant liquid drawn off, and the precipitate finally removed to large circular wooden filters, arranged as the gold filters with linen drilling, where the chloride is washed with boiling water until "sweetened," thereby rendering it free from all nitrate of soda and free nitric acid. The filtering tubs are three feet deep, three feet in diameter at the top, tapering to two and one half feet in diameter at the bottom.

REDUCTION OF THE CHLORIDE OF SILVER.

The drained chloride of silver is removed from the filter and placed in the lead-lined vats, about six feet long, two feet deep, and three feet wide, which are for the purpose of reducing the chloride of silver to the metallic state. This reduction is accomplished by adding to the silver chloride granulated zinc, water, and sulphuric acid. Thirty-three pounds of metallic zinc, and fifty pounds of sulphuric acid, of 60 degrees Baumé, extracts one hundred pounds of silver from the chloride.

Over these vats lead-lined wood-hoods are placed, connecting with a flue into the chimney, to carry off the hydrogen gas generated.

The granulated zinc is introduced all over the chloride, some water added, and finally concentrated sulphuric acid. Frequent stirring by hand with wooden paddles is resorted to, more diligently at first, as the action at first is very energetic, otherwise lumps are formed, which envelop unreduced chlorides, depriving them of the action of the zinc and acid.

A complete reduction is the most essential point to be gained in this operation, to ascertain which samples of the silver are taken and washed with concentrated ammonia; the ammonia solution is neutralized with nitric acid slightly in excess, and if no milky turpidity is perceptible the reduction is complete.

PURIFYING THE SILVER.

On the complete reduction of the silver, generally occupying six hours, a small quantity of sulphuric acid, of 40 degrees Baumé, is added, to dissolve any of the zinc not acted upon. After the zinc is dissolved the vats are filled with hot water, agitated, allowed to subside, and the solution is then siphoned off into the large reservoir, where small particles of silver are recovered. These last operations are repeated several times. The zinc and acid employed in this process are a complete loss.

The dark gray pulverent silver is removed to the large circular wooden filters, washed with boiling water until sweetened, when it is pressed and dried, as described with the pulverent gold, then melted; of which, more hereafter.

REFINING OF THE SILVER SLABS.

As before referred to, the silver "slabs," without inquartation, are placed in the earthenware vessels, digested, and operated upon in the same manner as in the process of inquartation, with this modification, however, that the pulverent gold, being of so small a quantity, is not further acted upon after the dissolving of the silver, but sufficient is allowed to accumulate to warrant the completion of finishing the refining of gold.

PARTING BY SULPHURIC ACID.

The separation of gold and silver by nitric acid is now almost universally superseded by the sulphuric acid process. The method with nitric acid is more expensive on account of the use of platinum, porcelain, or earthenware vessels, as well as the loss of the nitric acid, zinc, and sulphuric acid.

The origin of the sulphuric acid process is ascribed to the German chemist, Kunckel, in the seventeenth century, and is afterward referred to in the middle of the eighteenth century, by Scheffer, of Sweden.

To C. D'Arcet, Inspector-General of Assays of the Paris Mint, however, is due the first practical adoption of the parting on the large scale by means of sulphuric acid in platinum vessels; the first refinery for such purpose being erected in Paris in the year 1802.

A similar establishment was afterwards erected in London, in the year 1829, by Mr. Mathison, melter and refiner of the London Mint.

The most satisfactory results obtained by this process, in order to effect the highest state of separation, is by proportioning the alloy to be operated upon in quantities of one part of gold to two and one half parts of silver, by which the refined gold will contain an average, after parting, of only four parts of silver in one thousand. When the alloy is of the proportion of one part of gold to two parts of silver, the separation of the silver is not quite as complete; the gold will generally carry from eight to ten parts of silver in one thousand, and if proportioned in excess of one part of gold to two parts of silver, mechanical difficulties arise, the gold remaining too compact, thereby preventing the sulphuric acid from thoroughly permeating the remaining alloy, and the last parts of silver will not be as completely extracted.

The standard of fine gold required by the United States Mints is nine hundred and ninety fine, not allowing of more than ten parts of silver in one thousand. A small percentage of copper in the alloy facilitates the separation of the two precious metals; yet the alloy should not contain over 7½ per cent of copper, as the sulphate of copper formed is but sparingly soluble in concentrated sulphuric acid; but a small percentage of lead facilitates the dissolving of the copper alloys.

Alloys usually dissolve more readily and consume less acid, the less copper they contain.

Lead at times interferes with the solution, but the presence of 7½ per cent of copper and 5 per cent of lead at the highest, does not impede the separation.

From the economy with which this process is conducted, and the comparatively low price of sulphuric acid, as well as a return of the copper and sulphuric acid in the shape of bluestone, it admits of being profitably applied to the refining of silver containing 0.05 per cent of gold only, which, however, is not the case with silver containing even 0.10 per cent of gold by parting with nitric acid.

At the Vienna Mint auriferous silver containing about 0.09 per cent of gold is profitably treated, and likewise at the Freiberg refinery with 0.04 to 0.08 per cent of gold.

FURNACES AND VESSELS USED IN PARTING.

The parting of gold by sulphuric acid has been greatly facilitated by the use of platinum vessels; but on account of their great expense—$2,000 to $3,000 each—they are almost entirely replaced by castiron vessels. These are cast of white pigiron, and resist the action of concentrated sulphuric acid, the iron becoming electro-negative. The air must be excluded from these vessels as much as possible, and the using of dilute sulphuric acid must be avoided, as it dissolves the iron, forming sulphate of protoxide of iron, which, to a certain extent, reduces the sulphate of silver to an insoluble basic salt. After using, the inner surface of the iron vessel becomes coated with silver, which, to a great extent, prohibits the action of the acid on the iron. The iron of these vessels must be fine grained and compact, as well as free from all blisters. By continuous usage they will last two years, wearing down to one quarter of an inch in thickness, after which they cannot be used with any safety. In some European mints the iron that is used for these vessels contains from 3 to 4 per cent of phosphorus, thereby prolonging their durability.

These castiron vessels are either rectangular or vertical cylindrical shaped. The former are placed in a row of four, incased in iron plates in a brick furnace. They are uniform in size, two and one half feet long, one and one half feet wide, and two feet deep, three quarters inch in thickness, slightly flaring at the top, with flat bottoms one and one quarter inches in thickness. They are furnished with iron lids one half inch thick, cast into two halves, and are hung by chains with pulleys and counterpoised, one half provided with a lead tube, through which, during the operation, the anhydrous fumes evolved are passed through leaden conduits connected with leaden chambers, in which they are reconverted into sulphuric acids; or the fumes passing through the leaden pipe communicate with larger lead pipes partially filled with water, in which some sulphuric acid condenses; the surplus fumes, however, are here lost, passing into a well drawing chimney out into the air. Over the iron frames of the furnace a closely fitting lead-lined housing is attached, with sliding doors, by which the fumes are carried out into the chimney during the subsequent ladling out of the contents of the vessels into the receivers.

The rectangular vessels are the most preferable, the flat bottom presenting a larger surface to the fire, thereby exposing the gold to an even action of the heat; the action of the acid is uniform, and the gold in the last stages of dissolving is more easily stirred. They are also more economical, using less fuel than the cylindrical shaped vessels, and the acid is brought quickly to a boiling point, and readily kept boiling to the finish.

The cylindrical shaped vessels have closely fitting covers attached, made of castiron, kept in place by iron rings, which are screwed to the rims of the vessels. The covers are provided with openings through which the alloys and acids are introduced, and through which the stirring is done. From these openings the operation is readily watched, and from whence also the solution is ladled out. There is another opening in the cover to which a large leaden pipe bent at right angles is attached, passing into leaden conduits, through which the sulphurous anhydride escapes into a chimney. The evaporating sulphuric acid, with small portions of sulphate of silver, are caught in these conduits in water.

SOLUTION OF THE SILVER.

The parting methods by sulphuric acids is based upon the solubility of silver in boiling concentrated sulphuric acid (66 degrees Baumé), converting the silver into sulphate of silver, with the evolution of sulphurous anhydride; and the insolubility of the gold which remains in the bottom of the vessel in almost its purity, and converting the base metals into salts. The decomposition of silver represented by the following formula takes place: $2Ag+2H_2SO_4=Ag_2SO_4+SO_2+2H_2O$. The alloy of gold and silver, having been brought to its proper standard, the proportion of one part of gold to two and a half parts of silver is found to be the most suitable for the action of the sulphuric acid, is melted, granulated, and placed in the castiron vessels, the charge varying as to the quality of the alloys.

In dissolving the alloy about two to two and one half parts of sulphuric acid are usually employed, notwithstanding the fact that 0.9 parts concentrated sulphuric acid dissolves one part in weight of silver, but in practice more acid is generally used to redissolve the pasty crystalline sulphates, which would otherwise inclose and impede the dissolving of the silver. Here, also, the amount of acid employed depends considerably upon the quality of the metals, more so if much copper is present. About half of the sulphuric acid to be employed is added first to the granulations, and the vessels gently heated by means of a wood fire. Effervescence commences at the boiling, great precaution being here observed, so as to prevent portions of the contents of the vessel from overflowing, which is insured by the uniform admixture of cold acid in small quantities from time to time, and the fire being regulated accordingly. A temperature of 650 degrees Fahrenheit is maintained, which is the boiling point of the acid. The effervescence will gradually diminish, and by the time the last addition of the acid has been made, nearly all of the silver will be dissolved. It is necessary to stir the charge of granulated metal from time to time to prevent it from packing. Towards the completion of the dissolving, frequent stirring with an iron tool is resorted to, by which the remaining undissolved alloys will be freed from the surrounding sediments, and bared to the action of the acid. The parting should be completed in from three to four hours from the commencement of boiling. If the alloy contains a large percentage of copper, lumps of anhydrous sulphate of copper are formed, which adhere to the bottom of the vessel. To prevent the formation of these lumps constant stirring must be resorted to in the last stages of dissolving. A small proportion of copper in the alloy is an advantage, as the anhydrous sulphate of copper adheres firmly to the vessel, assisting in closely collecting the gold as well as clarifying the solution; and the iron of the vessel is less attacked, whereby less sulphate of protoxide of iron is formed.

Twelve to twenty pounds of sulphuric acid, of 55 degrees Baumé, are now added, to assist in the clarification of the solution. This acid is obtained as mother liquor from the crystallization of the bluestone. The contents of the vessels are stirred and boiled for fifteen minutes, after which the fire is withdrawn, the solution is allowed to subside and clarify in order that the gold may be deposited in the bottom, which will have taken place in an hour. The silver solution is next bailed out with iron ladles into the dissolving vat.

PURIFYING THE GOLD.

The gold remaining in the iron vessels containing crystallized sulphate of silver and base salts must, therefore, again be subjected to the action of boiling concentrated sulphuric acid for an hour, the acid having been previously heated in another vessel. During this hour a high heat is maintained, with copious evolution of sulphurous anhydride, after which the remaining hard and heavy gold will rapidly subside to the bottom, and the liquor is bailed out into the dissolving vat.

The gold is once more digested as above for an hour, when the fire is withdrawn, and this last acid containing but little silver, is set aside for the dissolving of fresh alloys.

The gold, while still hot, is dipped out from the vessel with an iron strainer into a lead-lined filter box containing hot dilute sulphuric acid, obtained from the condensers, and the last portions of gold are taken out with a hoe-shaped iron. The filter has a closely fitting cover attached, through the center of which the hot gold is introduced by means of a funnel reaching through the cover. The acid is diluted with hot, pure water, and the gold is washed with hot, pure water. These first washings are filtered into the injecting vat. These washings are continued until the wash water ceases to give the reactions for acid with litmus paper, and for silver by the test with salt water. The work is then proceeded with as described by parting with nitric acid. The gold obtained by this method will be almost "tough" upon melting, containing but a trace of lead, and will retain but three to four parts of silver in one thousand.

SETTLING THE SOLUTION.

The dissolving vats are made of wood and lined with heavy sheet lead. They are ten feet long, three and one half feet wide, and two and one half feet deep, and are provided with leaden pipes for the direct injecting of steam into the solution. They have closely fitting covers attached, in two halves, made of wood and lead-lined, for the inner covering, and hung by chains and counterpoised. Into these vats the washings, etc., from the "sweetened" gold and silver are injected, until two thirds full, by a steam injector made of lead. The supernatant liquor from the gold is bailed in through a funnel serving as a gutter, until the contents reach to within three inches of the top. The temperature is then raised to the boiling point by turning on the steam, frequently stirring the solution with wooden paddles, by which the sulphate of silver, which began to fall on cooking, is redissolved. Ninety parts of boiling water generally dissolves one part of sulphate of silver.

The liquid is brought to a specific gravity of 24 degrees Baumé. If it is brought up to from 26 degrees to 28 degrees Baumé, the subsequent precipitation with metallic copper is imperfect, the liquid showing a sparkling of separating crystals of sulphate of silver, requiring an addition of water to reduce the strength of the solution. The steam is shut off and the contents are allowed to settle, the boiling and settling being finished in three hours. This solution contains all of the sulphate of copper, and nearly all of the sulphate of silver. The sediments will consist of nearly all of the lead from the alloy, some basic sulphate of silver, and particles of gold, as well as graphite from the iron vessels. The sulphate of lead upon being bailed from the dissolving vessels into the water forms a milky solution, precipitating entirely in the water as an insoluble sulphate.

PRECIPITATION OF THE SILVER SULPHATE.

The clear solution is drawn off by means of a lead siphon while still very hot into the precipitating vats set at a lower level. These vats are of the same dimensions and lead-lined as the dissolving vats. Care must be exercised that none of the sediments are drawn over. In these precipitating vats copper plates, closely set together, are suspended. These plates are cast by remelting the commercial ingot copper, pouring the copper into iron-slab molds of two feet in length, ten inches in width, and from one to one and one quarter inches in thickness, each plate weighing from seventy to eighty pounds. These plates are used over again, until too thin for precipitating the silver, when they are remelted and cast into new plates.

The old sheet copper from vessels, when available, is well adapted for precipitating the silver in place of cast plates. The precipitating vats are closed with wooden covers to retain the heat of the solution, as the sulphate of silver is more rapidly converted into the metallic state in the hot than in the cold solution. The copper rapidly converts the sulphate of silver to the metallic state. In the course of four to five hours the last traces of silver sulphates are completely decomposed. To produce one hundred parts of silver from the solution about thirty parts of copper are dissolved, yielding one hundred and fifteen parts of crystallized sulphate of copper.

PURIFYING THE METALLIC SILVER.

The copper plates are divested of the heavy coating of metallic silver and cleansed of any adherent particles in the solution. The solution is allowed to settle to deposit any suspended particles of silver, which will occupy about an hour. The clear sulphate of copper solution, still of 24 degrees Baumé, is tapped off by a leaden siphon into an evaporating pan for crystallization. The metallic silver is removed with copper shovels to copper sieves standing on a second sieve covered with drilling; care being taken that no small particles of copper remain with the silver.

The silver is next washed with boiling water. As the first washings contain a large quantity of sulphate of copper, they are run into the injecting vat for the use of the dissolving vat, and the washings are continued until sweetened. The metallic silver is then pressed into round cakes of ten inches in diameter and four to five inches thick, by hydraulic pressure, thus retaining a moisture of about 10 per cent, and are then proceeded with as in the nitric acid process. The silver obtained as herein described will be from nine hundred and ninety-eight to nine hundred and ninety-nine fine, without any refining with niter upon melting.

REDUCTION OF THE SEDIMENTS IN THE SETTLING VATS.

The accumulated sediments in the dissolving vat, consisting of sulphates of silver and lead and some gold, are removed to a smaller vat and treated with metallic copper and steam, thereby reducing the sulphate of silver to the metallic state.

The sulphate of lead is not acted upon by the copper. The remaining metallic copper is removed, the solution given time to settle, and is then siphoned off and added to the injecting vat. The residue is then collected, thrown upon a filter, washed, dried, and heated to redness. It is next melted without the addition of any fluxes, in a clay crucible; the lead remains as a sulphate and forms a slag, covering the auriferous silver. This slag is removed and remelted with powdered charcoal, by which the lead is reduced to its metallic state, containing a large percentage of silver and some gold.

A SECOND METHOD OF PARTING—SOLUTION OF THE SILVER.

Another method of parting by the sulphuric acid is proceeded with in the following manner:

The granulated alloy is placed in the cylindrical-shaped vessels and the dissolving is proceeded with in precisely the same manner as in the rectangular vessels. The dissolving will be completed in about four to five hours. The liquors are allowed to cool and settle over night. The gold will form in a firm sediment at the bottom of the vessel, together with some sulphates of silver, copper, and lead, as well as sulphate of protoxide of iron. The solution is discharged next morning from the kettles by being siphoned off directly into the precipitating vats. The gold is pushed to one side to allow room for the siphon. In this process no dissolving vats are employed.

PURIFYING THE GOLD.

The gold is transferred to smaller and deeper cylindrical-shaped iron vessels and boiled twice with sulphuric acid for about two hours. The last acid, containing but a small quantity of sulphates, if clear, is used for dissolving alloys. Upon settling, however, the lower portion of this acid is often a muddy liquid. This muddy appearance of the liquid is probably due to the presence of anhydrous sulphate of protoxide of iron, which is insoluble in the boiling concentrated acid, as also due to scales of graphite, which are detached by the solvent action of the acid upon the iron vessel. This muddy liquid is bailed into a smaller vat, and the sulphate of silver contained therein reduced to the metallic state by the addition of granulated zinc. It is next washed, dried, and melted with bicarbonate of soda, no other flux being able to remove the graphite so rapidly. Or the metal obtained is fused in old black lead crucibles, to which some borax is added, and any sulphur it may contain is removed by the addition of old iron grate bars, with which the metal is repeatedly stirred, leaving the grate bars in the metal during the interval of stirring. The iron sulphide thus obtained will combine with the heavy dross upon the molten metal, the greater portion of the dross being the graphite, which is skimmed or ladled off with a small crucible cover. The surface of the metal is finally cleansed with a little bone-ash, and afterwards some borax added to facilitate the skimming, after which the metal is poured into molds, resulting in doré bars of nine hundred and forty to nine hundred and sixty in fineness of silver and gold.

The skimmed dross so obtained is then pulverized and vanned, by which means all of the globules of metal will be readily separated. After being dried they are melted with borax and poured into a mold, resulting in a small bar of about seven hundred to eight hundred fine.

The residue gold in the dissolving vessels, after the final boiling with sulphuric acid, is transferred to the filter boxes and proceeded with as already described. By this method considerable lead remains in the gold; also silver. Sulphate of lead is, to a great extent, soluble in boiling sulphuric acid of 66 degrees Baumé, and much more so when the acid is saturated with silver. On the cooling of the solution, however, a large proportion of the lead settles with the gold as an insoluble sulphate, which, in reboiling with concentrated acid, remains as an insoluble sulphate, thereby rendering the gold, upon melting, not only extremely brittle, but refining in the crucible must be resorted to to extract the lead. The gold, by this mode of parting, will contain from eight to ten parts of silver in one thousand.

PRECIPITATION OF THE SILVER SULPHATE.

The clarified solution from this method is bailed direct into the precipitating vats. The copper plates are disposed upon the bottom and upright along the sides of the vats. The vats are filled within one third of full with dilute liquors obtained from the first washings of gold and silver. As soon as the sulphate of silver solution has been added, the steam is turned on and the solution brought to a boiling point.

Most of the sulphate of silver separates when it comes in contact with the water; on boiling it redissolves, which solution is greatly promoted by constant stirring with wooden staves. The precipitation of the silver takes place more rapidly if the stirring is continued for some time, and if this is adhered to and the solution does not exceed a specific gravity of 24 degrees Baumé, the precipitation will be effected in about five to six hours. It is then proceeded with as previously described.

Upon melting this silver, considerable lead will be found associated with it—as much as from ten to twelve parts in one thousand, depending upon the original alloy operated upon. In parting auriferous silver, the metal is first granulated.

PARTING OF DORÉ BARS.

It has, however, become a custom to dissolve "doré" bars without first granulating, which is found not only to facilitate the regular action of the acid, but also to give a coarser gold, which is more easily washed than the mushy gold from the granulations.

This operation was first successfully accomplished upon Comstock bars by Mr. John Reynolds about twenty-five years ago, who at that time was employed at the San Francisco Assaying and Refining Works. These bars, weighing about one hundred pounds each, were placed in the flat-bottomed iron vessels, and the whole of the silver dissolved in from three to four hours. The charges in each vessel were enlarged to almost one third more, in weight of metal, than for the dissolving of the granulations. The gold did not need a second boiling, and upon being melted averaged nine hundred and ninety-six fine, and the parted silver being nine hundred and ninety-eight to nine hundred and ninety-nine fine.

A THIRD METHOD OF PARTING.

Auriferous silver, with but a small percentage of gold, is either acted upon in bars or in a state of granulations in the same manner as in the treatment of argentiferous gold, in so far as in the dissolving in the iron vessels. As soon as all of the silver is dissolved, very little time is allowed for settling, the turbid solutions being drawn off by means of a platinum siphon into the dissolving vat. The residue gold is left undisturbed in the iron vessels. Fresh granulations or bars are added thereto, again dissolved, and siphoned off into the dissolving vats, which operations are repeated until sufficient gold has accumulated in the dissolving vessels to finish that portion of the refining. This admits of an uninterrupted refining. The sediments in the dissolving vat are treated in the same way as before referred to, as also all necessary subsequent operations.

All the last continuous washings during the "sweetening" of the gold or silver are run into large reservoirs, where they are treated by salt water to precipitate the last traces of silver as well as to collect any escaping fine particles of gold or silver. The residue is collected and treated with other sediments for reduction.

The floor of the refineries are generally covered with sheet lead so that in case of spilling or of an accident the floor is readily mopped up. The filter cloths, mopping cloths, old wood filters, etc., are finally burned, the ashes are acted upon to reduce the metal contained therein and added to other sweeps, which are credited to the melting department.

THE CRYSTALLIZATION OF THE SULPHATE OF COPPER SOLUTION.

The solution of sulphate of copper, resulting from the precipitation of silver, is concentrated by evaporating in wooden lead-lined vats heated by a series of steam pipes running across the bottom. These vats are twelve feet long, eight feet wide, and two and one half feet deep. Sometimes the evaporation is effected in lead pans made of the heaviest sheet lead placed upon castiron plates one inch in thickness, which are heated by a wood fire.

The solution from the precipitating vats (still of 24 degrees Baumé) is transferred by means of a lead siphon to the evaporating pans and concentrated to 40 degrees Baumé, and thence run off into the crystallizing tanks, which are made of wood and lined with sheet lead; they are eight feet long, four feet wide, and four feet deep.

Crystallization is completed in from ten to twelve days, according to the temperature of the surrounding atmosphere, whereby crystals of crude blue vitriol are obtained. The acid mother liquors remaining, and of 36 degrees Baumé, are raised by means of an injector back to the evaporating vessel, and concentrated to 45 degrees Baumé, which, upon being run into the lower vats, yield a further crystallization of impure sulphate of copper.

The acid solution from this last crystallization is next concentrated to 55 degrees Baumé, which, upon cooling, deposits anhydrous sulphate of copper with sesquioxide of iron in combination. This clear acid solution is drawn off and used in the refining process as heretofore described.

All the impure deposits which are separated from the acid liquors are redissolved in water, and recrystallized, yielding a further supply of impure crystals. To obtain a merchantable bluestone, all the impure crystals thus obtained are dissolved in water in the evaporating vessels, the solution heated and concentrated to 36 degrees Baumé, run into the lower vats, and recrystallized. The resulting mother liquors of 25 degrees to 30 degrees Baumé, are again concentrated to 36 degrees Baumé, yielding a further supply of good crystals and a mother liquor of 30 degrees to 32 degrees, which is added to and used with the first liquors of the precipitating vats. The acid mother liquors become in time too much charged with iron, and will be of no further use; when such is the case the copper is recovered by precipitation on scrap iron. In Europe the iron is recovered from these mother liquors by concentration and crystallization as copperas.

After the removal of the mother liquor from the recrystallization, the bluestone is found adhering to the sides and bottom of the crystallizing tanks, the heaviest deposit being on the bottom, the crystals of which, however, are smaller than those on the sides. They are detached by means of copper chisels, removed to plates of lead pierced with holes, sprinkled with water to remove any adherent dirt, and left to dry, after which they are placed in barrels for the market. In place of the rectangular crystallizing vats, round vats are frequently used, of three feet in diameter and four feet in depth. These are bound with copper hoops, as sulphate of copper acts readily on iron. After the tanks have been filled with the solution for recrystallization, they are covered to prevent a too rapid cooling, as a gradual lowering of the temperature contributes to the formation of much larger, more beautiful, and more neutral crystals, which have a preference in the trade. The crystallization will be completed in from five to six days.

The round vats are preferable, as they are more convenient to handle, and can be turned bottom up, after the liquor is drawn, to drain, previous to detaching the crystals. It is always best to keep the crystals in a somewhat dark place till perfectly dry, so as to retain their deep blue color.

One pound of metallic copper, with 1.2 pounds of sulphuric acid of 60 degrees Baumé, produces 3.8 pounds of crystallized sulphate of copper.

THE GUTZKOW PROCESS.

ANOTHER METHOD OF PARTING BY SULPHURIC ACID.

The recovery of silver from the sulphate solution obtained in dissolving the alloys by means of sulphuric acid may also be effected by ferrous sulphate, thereby overcoming the tedious manipulation of precipitating by copper and recovery of bluestone in "parting refineries."

The process to be described is undoubtedly the best method of all those before mentioned in this article, being the most expeditious and the least expensive.

This method is the invention of Mr. F. Gutzkow, patented by him in the United States and England, and was successfully and profitably operated by him as early as 1867, at the then San Francisco Assaying Works, at San Francisco.

SOLUTION OF THE ALLOYS AND SETTLING OF THE SOLUTION.

The granulated alloys, or bars, are dissolved by sulphuric acid in iron vessels, similar to other processes described. The sulphate of silver solution obtained in the dissolving vessels is siphoned off into large iron pans, which contain the heated mother liquors of a previous operation. The siphoning is done by means of a vacuum formed by steam.

These pans are provided with closely fitting castiron covers resting on india rubber bands, thereby rendering them air tight during the addition of the sulphate of silver solution into the mother liquors. The covers are then raised by means of a pulley, and pure water added in sufficient quantities to give the silver solution a specific gravity of 58 degrees Baumé. The object of reducing the solution from 66 degrees to 58 degrees Baumé, by addition of water, is to clarify the liquor, by which the precipitation of the sulphate of lead assists in the clarification, and any particles of gold which may be in the solution readily settle in the bottom of the pan. The solution is again covered, without the use of the india rubber bands, the pans are heated by a wood fire beneath, and sufficient time is allowed for the clarification of the solution.

CRYSTALLIZATION OF THE SILVER SULPHATE.

As soon as the solution has become perfectly clear it is drawn off by a siphon into another castiron pan, which remains uncovered, and in which the crystallization of the sulphate of silver is effected. These pans are rectangular, and not over one and one half feet deep. The solution is allowed to cool to 80 degrees Fahrenheit, at which temperature nearly all of the sulphate of silver will have become crystallized. The cooling of the solution is assisted by each crystallizing pan being placed inside of a lead one, allowing of a flow of water between the two pans.

The supernatant liquors are then reconveyed into the first pan, which is the receiver of fresh sulphate of silver from the dissolving vessels, which is done on the principle of the Giffard injectors.

The crystallizing pans are so arranged that the liquid therefrom (when the crystallization is completed) runs into a small leaden well, from which the liquid is injected into the receiving pans, and into which also the last acid from the crystals drains into a vessel placed beneath the pan. The sulphate of silver crystals are thereby rendered as free from acid as possible, to facilitate their reduction into the metallic state.

The mother liquors from the crystallization of the sulphate of silver will naturally accumulate in quantity, for, as already stated, it requires less than one part of sulphuric acid by weight to dissolve one part of silver. The surplus of this mother liquor is therefore utilized as acid upon fresh alloys in the first stage of the operation.

DECOMPOSITION OF THE CRYSTALLIZED SILVER SULPHATES.

After the crystals (contaminated with oxide of copper) have been thoroughly drained they are shoveled into a wooden filter, similar to those in the other processes, with a stopcock between the real and false bottom attached. Upon the drilling of the filter a layer of precipitated silver is spread to facilitate the reduction of the silver to the metallic state.

A solution of sulphate of protoxide of iron of 25 degrees Baumé, and as nearly neutral as possible, is kept prepared in a large tank heated by steam. This hot solution is conducted in a small continuous stream, by means of a siphon, from a vat on a higher level flowing upon the mass of crystals on the filter, permeating the crystals, thence draining into the false bottom, from whence it runs, by means of a stopcock, into a tank, the crystals being occasionally stirred; the filtrate passing through changes its color from brown to a slight greenish.

The sulphate of protoxide of iron first dissolves the copper salts, then reduces the sulphate of silver to its metallic state and finally taking up, the acid set free, is converted into sulphate of sesquioxide of iron. The first filtrate is run into a small tank, provided it has a bluish color, owing to the presence of copper. This blue filtrate is allowed to become cold, whereby some remaining silver is precipitated; after the settling of the latter the solution is siphoned into a vat, in another part of the building, where the copper is recovered by means of scrap iron. This copper is dried, placed in a reverberatory furnace for oxidation, next dissolved in dilute sulphuric acid, and the sulphate of copper crystallized as already described.

As soon as the filtrate, passing through, changes to a deep brown it is run into another tank, and upon becoming cold will yield a further small precipitation of silver, which, in conjunction with that obtained from the bluish filtrate, is used as a filter layer for the succeeding reduction. The brown colored solution is now run into another large tank, in which some sheet iron is placed to change the converted ferric sulphate back to the original ferrous sulphate, where the last traces of silver and copper are precipitated, forming a muddy mass, which is reconveyed about once a week into the first settling pan. The ferrous sulphate solution as soon as it has become clear is forced back by an injector into the tank for further use on fresh crystals.

The reduction of the crystals of sulphate of silver to the metallic state occupies three to four hours, resulting in a heavy metallic mass, which retains the shape of the crystals. The reduction is completed when the solution passing through the filter assumes a pure green color. Sweetening as in the other processes is then resorted to, for the purpose of removing all the ferric sulphate, which is continued with hot water until the washings passing the filter give no blue precipitate on the addition of yellow prussiate of potash. The silver is then compressed and similarly proceeded with as in the other processes, which is the same with the gold obtained in dissolving by this process.

The residue in the first heating or settling pan, consisting of the sulphates of lead, basic salts, with graphite and fine particles of gold, are gathered once a month, sweetened with hot water, thereby dissolving any of the sulphate of silver. The residue is then treated with zinc, and proceeded with as described in another process.

MELTING OF THE REFINED METALS.

Previous to the charging of large quantities of metal into the crucibles, the crucibles, of sizes varying as to the amount of metal to be melted, are placed in a series of furnaces, the most common in use being fourteen inches square, fifteen inches deep in front and twenty-four inches in the rear, with level grate bars. They are built of common bricks, lined with fire-bricks, and have heavy castiron frames. The iron doors on top incline steeply towards the front, and slide in a groove. On the grate, formed of six to eight movable iron bars, supported by cross bars let into the brick work, a half fire-brick is placed for the crucible to rest upon. The brick protects the case of the crucible from the stream of air which is necessary for the combustion of the fuel, but which would destroy the crucible. Either coke or stone coal is employed as fuel. The black lead crucibles in which the fusion is effected should be well annealed before being placed in the fire to be charged, as they are liable to crack by too sudden an application of heat.

The annealing is generally done by placing the crucible on the front plate of the furnace, with the furnace door thrown open, exposing them to the heat of the fire after the day's melting is completed. The crucible is placed upright in the furnace on the brick and covered with a plumbago lid. A layer of charcoal of a few inches deep is then thrown around it, and then a layer of charcoal, previously ignited in another furnace, is thrown upon the first or unignited layer, and the furnace, after full ignition of the charcoal, is filled with coke. When the crucible is heated to a bright red, the metal is placed therein by means of tongs.

MELTING AND TOUGHENING OF THE PURIFIED GOLD.

The gold obtained by the parting processes is rarely sufficiently fine, soft, or ductile, owing to the presence of small quantities of lead and antimony. This hard and heavy gravelly-appearing gold is broken up easily in suitable fragments for the crucible, in which it is placed with the addition of a small quantity of borax. From four to five thousand ounces are generally operated upon, in one crucible, to be toughened. As soon as the first charge has partly melted, further additions of gold are made, until the crucible is sufficiently full of molten metal to permit of refining and toughening. To render the charge completely tough, it is first treated with niter, as the platinum retained by the gold lessens its ductility, and a trace of lead is sufficient to render the gold brittle.

In using niter on large quantities of metal some bone-ash is introduced first, which floats on the molten mass, as in making black lead crucibles coke is incorporated, which is readily attacked by fusible oxides converted from their metallic state by the niter. The bone-ash, to a certain extent, prevents the oxides attacking the crucibles. Niter is added to the center of the fusing mass in small doses. After the several additions of niter, the number and amount depending upon the quantity of platinum or base metals present, the slag should be of a medium consistency, neither too liquid nor too pasty, but of a degree to permit of its being readily skimmed. If the slag is too pasty, the small globules of gold cannot settle beneath it, and will be taken up in the skimming.

A skimmer is a round iron rod, with a coiled termination, of from one and one half to two inches in diameter, which is placed in contact with the slag, a portion of which will adhere thereto; it is then quickly withdrawn, pressed on the oiled plate in front of the furnace to chill and to flatten the adhering slag. It is then again touched to the slag, the operation being repeated several times, with an occasional dipping in water with an immediate withdrawal, to hasten the cooling of the slag.

If too large a quantity of slag has accumulated on the skimmer it is immersed in cold water and knocked off. If but little slag is left on the molten metal the latter is liable to adhere to the naked skimmer when brought in contact therewith; therefore, when the last particles of slag are to be removed, it is well to have some slag adhering to the skimmer. Not any slag should be left adhering to the sides of the crucible. After skimming there should be sprinkled, from time to time, small amounts of sal-ammoniac, this being the reagent to expel the last trace of lead. Fine gold, at 2016 degrees Fahrenheit, will present a brilliant greenish color, and an experienced melter should be able to judge within one one thousandth of the fineness of this molten metal.

The refining is completed by repeated additions of corrosive sublimate, which converts the last traces of base metals into volatile chlorides. After stirring the metal, a portion is dipped out and poured into a long, shallow mold, allowed to solidify, and is cooled in water, then folded back upon itself by hammering; no fracture being sustained, it is considered tough. This sample, with an addition of 10 per cent of copper, is melted in a small crucible, well stirred, poured again into the shallow mold, and cooled in water. When cold, it is cut in two by a shearing machine, to ascertain by its fracture whether the gold will properly alloy with the copper and retain its toughness, and if not, the toughening of the gold will have to be continued by the before mentioned reagents. The sample having proved satisfactory, the molten gold is covered with a thin layer of powdered charcoal and thoroughly stirred with a previously heated black lead spatula; then a sample is taken out by a black lead dipper and poured into a small mold. A sample from the metal in a state of fusion is always the most reliable. The metal is ladled out by means of a black lead dipper, previously heated to bright redness, into warmed and oiled molds.

When nearly all of the gold has been ladled out, another sample is poured into a small mold; the crucible is next withdrawn from the fire with a pair of stout tongs, its contents poured into a mold, with the exception of a few ounces, which are left to cool in the crucible, forming a regulus, which may contain some osm-iridium, which does not alloy with the gold, but if not removed therefrom will cause defects in the making of coin. As each mold is filled with the molten metal, a layer of powdered charcoal is strewn over its surface, as a protection from the air, until the pour is solidified. When the bars are set, they are turned out of the molds, immersed in water, and any adhering matter removed.

It naturally depends upon the accuracy of the parting process how much time will be consumed for the toughening of the gold. The fusion in a bright red fire, from the commencement of introducing the gold into the crucible to the point of being fully charged and ready for refining with niter, generally occupies from one to one and one half hours. The refining and toughening will vary from one to three hours. If the parting process has been neglected, the gold will often retain as much as ten parts of silver in one thousand. Nearly all refined gold contains some platinum, whereby also the amount of silver retained by the gold is increased. The platinum, to a great extent, is extracted by the niter and enters the slag; the latter also containing soluble salts of base metals, with some components of the crucible intermixed, as well as small shots of gold mechanically combined. These slags are pounded up and sifted to recover the larger shots of gold, and are then melted with potash; the result being a very small button which is submitted to refining with other regulus, and afterwards extracted with the alloys.

MELTING OF THE PURIFIED SILVER.

The melting of the refined silver is completed in one fusion with borax in plumbago crucibles, capable of holding four thousand to four thousand five hundred ounces of fused metal.

It is broken up in convenient pieces, the crucible is gradually but as rapidly filled as the metal subsides, the filling of which should not be retarded by waiting until the same has quite melted, but the additions are made not later at all events than the melting mass is in a pasty condition, otherwise spattering of the metal may occur. When the crucible is sufficiently filled, and the metal is in a state of fusion, some bone-ash is sprinkled over it. A small plumbago crucible cover is heated to a bright red, held by a pair of tongs, and the slag and bone-ash lightly but thoroughly intermixed, after which it is removed with this small cover into an iron dish. If the silver is plumbiferous rainbow colors appear, rapidly moving about on the surface; if a large amount of lead is present the metal fumes. If it becomes covered with a scum it likely contains iron in conjunction with copper and often sulphur. When any of these bases are present a layer of fine bone-ash is placed around the sides of the crucible whence it will float over the metal. An opening in the center is made by pushing the bone-ash with a stirrer, and niter is thrown in the opening thus made.

This layer of bone-ash gradually absorbs the oxide of the bases formed by the niter. The addition of niter is several times repeated, and the dross formed is skimmed off and retained with the first slag. The bone-ash and niter refining is repeated till the silver is of sufficient fineness.

During the refining with niter the dampers of the furnace must be closed and the furnace left partly open, for the reason that the temperature of the silver would become higher than the necessary melting point.

To ascertain if the silver is of sufficient purity a portion of the slag is moved away from the center of the fluid metal by a rod or stirrer; if the metal appears extremely brilliant, without any decided movement or the least discoloration, such as appears so notably in cupellation, it is sufficiently fine. Here, likewise, will an experienced melter predict the fineness of the metal within one one thousandth from its appearance in the crucible.

The silver is then again skimmed of its dross, a little powdered charcoal added, left to ignite, thereby reducing any base-oxides formed, and the skimming repeated with additions of charcoal, until the metal presents a clean, bright surface.

The metal is then covered with a thin layer of charcoal dust, and left to tranquillize for a short time. Should the temperature of the fire have become too low and the silver having lost its decided movement, the dampers are opened prior to the last skimming of the slag, the crucible afterwards covered and the furnace door closed, which rapidly increases the heat to the proper temperature. Molten silver, undergoing a long treatment with niter, frequently shows a peculiar bubbling, which seems unavoidable. Should the bubbling of the silver continue, repeated stirring with a black lead spatula must be resorted to, keeping the metal covered with charcoal dust, till the bubbling has ceased. If this metal, while in a bubbling condition, should be poured into a mold, it would very likely, at the point of solidification, sprout at the surface into most minute particles; if covered by a heavy lid heavier effervescence follows, lifting the cover. In this case the bar is not marketable. The minute particles are often carried quite a distance from the mold, accumulating in sufficient quantity to be swept up. The cause of this is difficult of explanation, though it might be attributed to long refining with niter; the silver being constantly covered may occlude some of the oxygen of the niter, more so in the presence of copper.

The time occupied in making a silver melt is generally one and one half hours, and the refining with niter from one half hour to three hours, depending upon the amount of base metals present.

To make the resulting bars presentable for the trade, smooth rectangular iron molds, capable of holding from one thousand two hundred to one thousand four hundred ounces, are smoked in a chamber by burning resin or turpentine.

When the silver in the crucibles has been treated as just described, and the necessary fineness acquired, the mass is thoroughly stirred; the crucible with its contents is then withdrawn from the fire by first drawing a bar from the grate on each side of the crucible, forcing the fuel into the ash-pit. A pair of clasp tongs connected by pulleys to a crane is then made to encircle the crucible at its middle. The crucible is thus lifted out of the furnace, and the metal cast into the smoked mold by a workman holding the end of the clasp tongs and tilting the crucible. Another man retains the pulley chain to assist in its guidance; a third removes the charcoal from the spout of the crucible by means of a stick, so as to render a clear stream of the metal. Each mold, when sufficiently filled, is covered with a closely fitting iron lid. The crucible, emptied of its contents, is returned to the furnace, the iron bars that were withdrawn replaced, and the ignited fuel taken from the ash-pit, thrown into the furnace around the crucible, which is again charged with more silver. A crucible, if carefully handled, serves for about twelve charges, and if it has not been subjected to excessive uses of niter, may even be oftener used.

During the pouring of the metal (each crucible charge making three bars) two samples are taken and poured into a small mold, one from the first and one from the last pouring. The samples (for the assay of the metal) are stamped with the same number as the corresponding bars. Sometimes the metal is bailed from the crucible by means of a plumbago dipper, without having to disturb the grate bars, into a smaller crucible previously heated to a bright red, capable of holding sufficient metal for a bar at one time. This smaller crucible is placed in a carrier, which, upon lifting the crucible, retains it below the center. To the ends of the carrier cross-bars are welded on. When the crucible is about two thirds full two men lift the crucible, tilt it, and pour the metal into the mold by means of the carrier, thus repeating until the three bars are cast from each crucible, and in every other respect following the principles as recorded above.

When the bars have solidified they are turned out of the mold, and immersed in water slightly acidulated with sulphuric acid. These fine glossy appearing bars are weighed and stamped.

The bars, when manipulated as above described, average nine hundred and ninety-eight fine, the standard of the trade being nine hundred and ninety-seven and one half fine, and they are generally exported to the Indies and China. This silver could be refined to a fineness of nine hundred and ninety-nine to nine hundred and ninety-nine and one half, which, however, is not desirable, as the mints make no allowance for such fine silver, the standard for commercial purposes being nine hundred and ninety-eight fine.

When the fine silver is to be operated upon for coinage, it very seldom has to be refined upon melting, especially when obtained by the sulphuric acid process, the base chiefly consisting of copper, which is the alloy for the coin; the silver, unlike the gold, generally being sufficiently tough, though some lead may be retained. All silver coin contains some lead.

The crucibles, as in the first place, are charged with the silver, with the addition of a little borax, and after being skimmed clean, the contents are bailed into warmed and oiled molds, holding about eight hundred ounces each.

It is requisite to always keep the silver covered with charcoal dust, to prevent its volatilization by free contact of the air. Each melting, including the pouring out, will occupy about two hours. The necessary assay samples are here likewise taken.

REDUCTION OF THE DROSS IN MELTING GOLD AND SILVER.

The slag resulting from the silver melting is fused in old crucibles, either with potash or with a large portion of borax, which in both cases will form a regulus in the bottom of the crucible; or it is melted with litharge and borax, or glass, forming a regulus, which is afterwards cupelled.

All the regulus obtained from the various processes are melted into a bar and assayed, to check the account of each manipulation. After this they are remelted into larger bars and supplementarily refined, for the purpose of again extracting with fresh alloys.

All the old crucibles, the slags, the ashes of the fuel, the dross and ends of the furnaces, sweepings, etc., are finely pulverized in a chili mill, consisting of two castiron grinding rollers of twenty-eight inches in diameter, each having a twelve-inch face. The pan thereof, revolving twenty-four times per minute, is made of castiron four and one half feet in diameter, with a rim attached of six inches in height and one inch in thickness. The pan has a die two inches thick.

After the material has been ground it is sifted, whereby any shots of metal are recovered, and the pulverized material is further treated in amalgamators to recover a further amount of precious metals. The tailings hereof are concentrated, the concentrations dried in large ovens, and sold, to be smelted at lead works. The melter and refiner is credited with these savings.

The shots of metal obtained from the sifted "sweeps" are associated with a large amount of iron; they are melted when a suitable quantity is obtained in an old crucible, with an addition of borax, and treated, to obtain a regulus, with sulphur, as before described for treatment of gold with a large percentage of iron.

The amalgam is retorted, melted, and treated in like manner with sulphur to convert the iron into sulphide, by which means in both cases a regulus is obtained of very fair metal, with iron sulphide on the surface, which, after cooling, is readily detached. During the year, by the described process, a great deal of base bullion, containing a large proportion of lead, is accumulated. This is finally treated in a reverberatory cupel furnace, producing an alloy of fine gold and silver.

SEPARATION OF ALLOYS RICH IN COPPER.

Alloys very rich in copper are melted and then granulated. These granulations are placed on the hearth of a reverberatory furnace. The hearth, in place of bricks, is composed of heavy iron plates, whereby upon heating the copper becomes superficially oxidized. The mass is then withdrawn from the furnace, and thrown into large, leaden vessels, and boiled with sulphuric acid of 20 degrees Baumé, with repeated stirring, to dissolve the oxide of copper formed in the furnace. The copper solution is siphoned into a vat below, and the remaining granulations are washed on sieves to remove the adherent acid, and these sweetened granulations again superficially oxidized in the furnace.

This process must be repeated several times. The first copper liquors are used to dissolve the oxide of copper till they are 30 degrees Baumé.

Some silver will eventually become oxidized, but not till nearly all of the copper has been extracted. The sulphate of copper solutions are tried for silver by reaction with salt. Upon concentrating the copper solution to the degree for crystallization, scrap copper is added, thereby reducing any silver present to its metallic state.

The concentrated copper solution is allowed to stand until clear, and is then run off into vats for crystallization. The sediments remaining are gathered and treated in the usual manner, and finally melted.

The alloy remaining and containing very little of its original copper is next treated with boiling concentrated sulphuric acid, provided the proper proportion of silver and gold was found by assay in the original copper alloy, and proceeded with as parting on the large scale with alloys. If, however, there is not sufficient silver present in the alloy, it is melted with additions of niter, and the resulting argentiferous gold submitted to the extraction process.

This method is adopted to save the large amount of sulphuric acid involved if such alloys are treated direct with concentrated sulphuric acid, as the dilute acid readily dissolves the oxide of copper, without the wastage of the sulphuric acid.

CHLORINE PROCESS.

SEPARATION OF SILVER FROM GOLD IN THE MOLTEN STATE BY CHLORINE GAS.

In 1838 Mr. L. Thompson investigated the action of chlorine gas in the separation of silver from gold while in the molten state, the result of which he presented before the Society of Arts of England, who printed such in 1840, in which he states:

> That not only has gold no affinity for chlorine at red heat, but it actually parts with it at that temperature, although previously combined; that is to say, the chloride of gold is reduced to its metallic state by heat alone, and it cannot, therefore, possess any affinity for chlorine when red hot. This, however, is not the case with those metals with which it is usually alloyed. It offers, therefore, at once an easy and certain means of separation
>
> The application of these facts is all, therefore, to which I can lay claim, as the facts themselves have been known for many years, and the reasons why they have not so been applied is, that hitherto chemists have not directed their attention to this art, but have left it entirely in the hands of the assayers, who are, for the most part, ignorant of chemistry.

Mr. B. F. Miller, assayer of the Sydney Mint, Australia, in 1867 practically applied this treatment for the separation of the silver from the gold while in the molten state, it being the most economical process they could there apply, owing to the high price of acid in that country, as well as the most important feature of having no crude silver for the "acid parting process." Even in having a supply of fine silver on hand, which, after each refining, would have to be again treated with crude gold, the expense of such process is large, the refining charges of crude silver being lost to the metallurgical works. Such was the case frequently at the San Francisco Mint, prior to the large yield of silver from the Comstock.

Miller's process is patented both in the United States and England, and has been successfully used in the Royal Mint of London, by Mr. Roberts Austin, in "toughening" extremely brittle gold in a comparatively short time, and in a more economical manner than that with corrosive sublimate. Mr. Miller describes the process as follows:

> The furnace required for this operation is the ordinary melting furnace, with the flue as near the top as possible, so as to allow of the crucible standing high up in the furnace, without being cooled by the draught, and of such a depth that the bottom of the crucible, when it is placed in the fire, is not more than three inches above the grate bars. The furnace is generally twelve inches square.
>
> The covering of the furnace consists of two fire tiles, seven and one half inches long and fifteen inches long, one of which has a slot or hole in the center to allow the chlorine tubes to pass through. An iron cover would become too hot for the convenience of the workmen.
>
> The crucibles employed for the refining are the French white fluxing crucibles. They are fitted for use by filling them with boiling aqueous solution of borax, letting it remain therein for ten minutes, then pouring it out, and afterwards drying them. The crucibles thus prepared are heated to redness, whereby the borax forms a glaze on their inner surface, thereby rendering them impervious to the infiltration of the very liquid chlorides of silver.
>
> When used for refining they are placed within black lead crucibles as a precaution against loss, should the furnace crack, which, however, seldom happens.
>
> The crucibles are covered with loosely fitting lids, with the requisite holes through them for the passage of the clay chlorine pipes, etc. Ordinary clay tobacco pipe stems, one half inch in diameter, twenty-two inches long, three sixteenths inch bore, have been found to answer well for the purpose of passing the gas through the molten gold. (Pipes are now expressly furnished for this purpose by the Battersea Crucible Works in England.)
>
> Two pipes are used at a time in one crucible.
>
> Before immediate using, the lower end of the pipe should be heated for about ten minutes; if not, it is liable to split.
>
> The chlorine generator consists of the best stoneware acid jars; capable of holding ten to fifteen gallons, and furnished with two necks. One of these openings is stopped with a vulcanized india rubber plug, through which two glass tubes pass tightly—the eduction tube, and the safety or pressure tube, the length of the former being a few inches, and the latter from eight to ten feet.

The other opening is intended for introducing oxide of manganese, etc., and is closed with a leaden plug, covered with a stout piece of india rubber, and well secured.

On the bottom of the generator is placed a draining layer, so called, of small quartz pebbles, down nearly to the bottom of which the pressure tube should extend. On this layer should be placed from seventy to one hundred pounds weight of binoxide of manganese in grains, in pieces of about one quarter inch cube, sifted from powder. This quantity will be sufficient to effect many refining operations, and will obviate the necessity of repeated dismantling of the apparatus.

Each generator should be suspended to about half its height in a galvanized iron water bath.

The chlorine gas is produced, when required, by pouring common hydrochloric acid down the safety tube, the apparatus being warmed by means of gas burners beneath the water baths.

The gas is conveyed from the generators by means of a leaden pipe fitted with branches to supply the several furnaces, all intermediate connections being formed by means of vulcanized india rubber tubing, which, if screened from direct radiation from the fire, stands the heat well, even immediately over the furnace.

All joints between the various pipes and india rubber tubes are easily secured and rendered perfectly gas tight with a cement consisting of a thin solution of india rubber in chloroform.

Screw compression clamps on the india rubber tubes give the means of regulating the supply of gas as required, and enable the operator to shut it off entirely as soon as the refining is over. The chlorine then, having no means of escape, accumulates in the generator, and soon forces all the acid up the safety tube into a vessel placed above to receive it; and the acid no longer acting on the oxide of manganese, the supply of gas of course ceases. Two such generators as are here described, and three ordinary gold-melting furnaces, have been found capable of refining daily about two thousand ounces of gold, containing about 10 per cent of silver, between nine A. M. and two P. M.

The French crucibles, say size seventeen or eighteen, duly prepared with borax, having been placed in the cold furnace and slowly and carefully heated to dull redness, the gold, from six hundred to seven hundred ounces to each crucible, is introduced and the fire urged until the metal is melted, the necessary generation of chlorine having meantime commenced by the introduction of a little hydrochloric acid poured down the safety tube into the generators.

As soon as the gold is melted, from two to three ounces of borax, in a state of fusion, are poured upon its surface. If the borax is added sooner it acts too much on the lower part of the crucible, and if thrown in cold is apt to chill the gold. The clay pipe, which is to convey the chlorine to the bottom of the molten gold, is now introduced. At the moment of its entering the molten gold, the screw compression clamp is slightly loosened, so as to allow a small quantity of gas to pass through it, and thus prevent any metal rising and settling in the pipe, which is then gradually lowered to the bottom of the molten gold, where it is kept by means of a few small weights attached to the top. The compression tap is now quite relaxed, and the gas is heard bubbling up through the molten metal, which it does quietly and without projection of globules from the pot.

Sufficient hydrochloric acid must be added to the generators from time to time to keep up a rapid evolution of chlorine. The column of liquid in the safety tube, acting as it does like a barometer, affords a ready means of knowing the pressure in the generator, and of judging of the rate of production of the gas, as well as at once showing by its fall if anything irregular has occurred, such as a leak or a crack of the chlorine pipe or crucible. From sixteen to eighteen inches in the safety tube correspond to and balance one inch of gold in the refining crucible. When the chlorine is first introduced into the molten gold, a quantity of fumes is seen to pass up from the holes in the crucible lid; these are not chloride of silver, but the volatile chlorides of some of the baser metals, and they are especially dense when much lead is present in the alloy under treatment, forming a white deposit on any cold substance presented to them. After a time, longer or shorter according to the impurities in the gold, the fumes cease. So long as any decided quantity of silver is present in the molten gold, the whole, or nearly the whole, of the chlorine is absorbed, little, if any, appearing to escape and to be thus wasted, and it is found that the better the supply of chlorine, the quicker is the operation. It is essential in using chlorine that the gas should pass to the very bottom to effect a complete refinage.

As soon as the operation is nearly over, fumes of a darker color than those observed at the commencement make their appearance, and the end of the refinage is indicated by a peculiar flame or luminous vapor of a brownish-yellow color, occasioned by the free and now waste chlorine escaping, which can be seen on removing a small plug which fits into a hole in the lid of the pot. This, however, of itself is not a sufficient indication. The process is not complete until this flame imparts to a piece of white tobacco pipe, or similar substance, when held in it for a moment, a peculiar reddish or brownish-yellow stain; so long as it gives any other color, the refinage is unfinished.

When these appearances are observed usually for gold containing about 10 per cent of silver in about an hour and a half from the introduction of chlorine, the gas is shut off and the crucibles removed from the fire; the white crucible lifted out of the black one, and, together with its contents, allowed to stand for several minutes, until the gold becomes cool enough to set or solidify. The chloride of silver, which remains liquid much longer, is poured off into iron molds. The crucible is then inverted on an iron table, when the still hot gold falls out in the shape of a cone. This is slightly scraped and thrown hissing into a concentrated solution of common salt to free it from any adherent chloride of silver. An alloy containing originally 89 per cent of gold, 10 per cent of silver, and 1 per cent of base metal, will yield, on an average, a cake of chloride weighing, with a little adherent borax, fifteen ounces for every one hundred ounces operated on.

It is necessary to very carefully dry and heat the molds into which the chloride of silver is poured, as the slightest moisture causes the latter to be violently dispersed, to the great risk of the bystanders.

The gold is now fine, and simply requires melting into ingots.

As before stated, it is found that all these operations can readily be performed, and about two thousand ounces refined per day in three common melting furnaces, in five hours; 98 per cent of the gold originally contained in the alloy operated on is then ready for delivery. The other 2 per cent remains with the chloride of silver, partly in the metallic state and partly in a state of combination with chlorine, and probably with silver. To free the chloride of silver from this combined gold it is melted in a boraxed white pot, with the addition of from 8 to 10 per cent of metallic silver, rolled to about one eighth of an inch in thickness. The chloride of gold is by this means reduced at the expense of the metallic silver, chloride of silver being formed, while the liberated gold sinks, and melts into a button at the bottom of the pot. As soon as the whole is thoroughly melted the crucible is removed from the furnace and allowed to stand about ten minutes, and the still liquid chloride of silver is then poured into larger iron molds, so as to form slabs of convenient thickness for the next operation, that is, the reduction to the metallic state.

After the fusion of the chlorides a small quantity of a curious spongiform substance adheres to the sides of the crucible used, probably consisting of subchloride of silver; but since it always contains a little gold, care has to be taken in pouring off the fluid chlorides to prevent this auriferous sponge from falling out and mixing with them. The slabs of chloride of silver are reduced without difficulty by plates of wrought iron or zinc in the usual way.

Besides the separation and recovery of the silver, as above described, another useful end is gained by this process—that of having converted the "brittle" into "tough" gold.

In the metallurgic treatment of the precious metals, some loss is always sustained; but that, in the process here described, is found very small. The average loss of gold in operating hitherto has been found to amount to nineteen parts in every one hundred thousand of alloy treated, which is considerably less than would be met with in toughening an equal amount of gold with corrosive sublimate in the ordinary manner. The loss of silver has amounted to two hundred and forty parts in every one hundred thousand of alloy operated on (containing originally, say 10 per cent of silver). There is no doubt that a considerable portion of both these losses would be recovered on further treating the crucibles and ashes remaining after the operation. In refining, on the large scale, gold containing 10 per cent of silver, the cost of the operation in Sydney is about 5 farthings per ounce. The fineness of the gold produced by this process varies from nine hundred and ninety-one to nine hundred and ninety-seven in one thousand parts, the average being nine hundred and ninety-three and one half. The remaining six and one half thousandths are silver, and this compares favorably with any of the previously known practical processes.

The silver resulting from this method of refining is tough, but its quality varies somewhat according to the gold originally operated on. If the alloy treated contains much copper, the greater part of this remains with the resulting silver, but the other metals are nearly all eliminated.

The fineness of the silver hitherto obtained has varied from 918.2 to 992 in one thousand parts, the average being 965.6. Analysis of the silver resulting from the refinage of gold, known originally to have contained, among the base metals in the alloy, copper, lead, antimony, arsenic, and iron, gave the following results:

Silver	972.3
Copper	25.0
Gold	2.7
Zinc and iron	Traces.
	1000.0

REDUCTION OF THE CHLORIDE OF SILVER OBTAINED BY "MILLER'S" PROCESS.

In a paper subsequently read before the Royal Society of Victoria, Dr. A. Leibius, assayer to the Sydney Mint, described a new apparatus for the reducing of the chloride of silver obtained by Miller's chlorination process. He describes his process as follows:

In 1868, Messrs. De la Rue and Hugo Miller, in London, constructed a galvanic battery, one pole of which consisted of fused argentic chloride the thickness of a goose quill, the other pole of cylinders of zinc. Adopting this principle, I have endeavored to construct an apparatus which should fulfill the requirements before referred to.

After operating successfully with a small model, which allows the reduction of about two hundred and fifty ounces of argentic chloride in one operation, I have, with slight modifications, constructed an apparatus which will reduce from one thousand four hundred to one thousand five hundred ounces of argentic chloride in twenty-four hours. The apparatus and its dimensions are as follows:

Two thick boards, fifteen inches long, are joined together on both ends by three strong battens, so as to form an open box without a bottom, thirteen inches long by fourteen inches wide, and fifteen inches high (inside measurement). The two boards forming the length of the box or frame contain seven vertical grooves, one half inch wide, and one half inch deep, at intervals of one and one half inches from each other. These grooves are cut down to a length of twelve inches, leaving three inches of each board forming the legs of the frame.

At the termination of these grooves passes horizontally a narrow slit, one half inch deep, and along the whole length of each board, into which a strip of metallic silver, one half inch wide and the thickness of about a three-penny piece, is tightly fixed, projecting on one side of the frame about eighteen inches beyond each board.

The seven grooves, already alluded to, are for holding zinc plates, one half inch thick, fourteen inches long, and twelve inches high, which rest on both sides on the strips of silver, which, as just described, are jammed horizontally into the sides of the two boards. A connection is thus established between the seven zinc plates and these strips of silver.

The second part of the apparatus consists of a wooden frame, cut out of a solid board one inch thick, and supplied with two large iron handles. This frame is the same length as the box holding the zinc plates, but three inches narrower. It contains, on each side, parallel to the direction of the zinc plates, twelve slits, one half inch long, which hold silver bands, one half inch broad and the thickness of a three-penny piece. These silver bands are passed through the slits in the board, so as to form on each side of it six loops, eleven and one half inches in length and seven eighths of an inch wide. The six loops on one side are exactly opposite to those on the other side of the boards, at a distance of about nine inches. They are intended to hold the slabs of argentic chloride, which are twelve inches long, ten inches high, and about three fourths of an inch thick, and are put through these loops lengthwise, projecting on each end about one inch beyond the silver bands.

The whole frame holds, as before stated, six of these slabs of argentic chloride, which are placed between the six spaces formed by the seven zinc plates, from which latter they are about one quarter inch apart on each side.

The projecting horizontal strips of silver jammed into the sides of the lower frame are then connected with the ends of the silver forming the loops in which the argentic chloride is suspended, and the whole apparatus, thus charged, is placed in a tub filled with water. After a short time galvanic action is discernable, the liquid gets gradually warmer, and a strong galvanic current is observed. After about twenty-four hours the action has nearly ceased, and the whole argentic chloride is found to be completely reduced to metallic silver, which retains in the silver loops the same shape, and outwardly also nearly the same appearance, as when first introduced as argentic chloride. The latter contains always more or less chloride of copper (eliminated, together with the silver, during the operation of refinage by chlorine), which is reduced together with the chloride of silver; in fact, this soluble chloride of copper helps to act as an exciting liquor for the battery. In the first experiments a weak solution of salt (chloride of sodium) was used as exciting liquor, but it was found that this could be dispensed with, and only common water used. The action, however, is, in this case, a little retarded, and does not become powerful until about two hours after the battery is set. By using a part of the resulting liquor from a previous reduction of argentic chloride, and which contains chloride of zinc, it has been found that the galvanic action sets in very rapidly, and accelerates thereby the completion of the reduction.

No acid is used; and, therefore, the amount of zinc used in each reduction has invariably been found to be almost the theoretical quantity required to combine the chlorine of the argentic chloride treated with the metallic zinc, in order to form chloride of zinc. The quantity of metallic zinc thus used was always from 24 to 25 per cent of the weight of the argentic chloride reduced.

The reduced silver is boiled out in acidulated water, in order to remove the basic and oxychlorides, and finally in pure water, while still suspended in the silver loops. As soon as it is taken off the last boiling, it is immediately ready for the melting pot, since the heat from the boiling water dries the porous mass of silver sufficiently to allow of its immediate melting. The seven zinc plates, when first used, weigh about one hundred and forty pounds avoirdupois; the six slabs of argentic chloride of the dimensions already given, weigh about one thousand four hundred ounces troy.

The zinc plates are used over again, until too thin for that purpose, when they are remelted and cast into new plates. It has been found that the quantity of zinc used is little, if at all, increased by prolonging the time of connection with the silver plates after the reduction is completed; the whole apparatus, when once set in operation, can, therefore, be left to itself until it is found convenient to melt the reduced silver.

While this apparatus reduces the argentic chloride much quicker than if the latter is simply placed in contact with zinc or iron plates, it obviates any handling of the argentic chloride from the time the latter has been placed in the silver loops until the reduced silver is ready for the melting pot, advantages which have been fully appreciated by those who formerly had to resort to tedious and disagreeable manipulations.

COINAGE AT THE MINTS.

The supervision of the mints by law is committed to one principal officer, named the Director, who is under the general control of the Secretary of the Treasury. The operation of each mint is divided into several departments, such as: receipts and disbursements, assaying the precious metals, including the primary melting for assays, melting and refining for coinage, coining in all its branches.

It is regulated by law that the gold bullion brought to the mints for coining shall be received and coined by the proper officers, for the benefit of the depositors; and that it shall be lawful to refuse at the mints any deposit of less value than $100, and any bullion so base as to be unsuitable for the separation. The gold bullion is received by the proper officer, who weighs it in the presence of the depositor, records the transaction with its description, and gives a receipt; the hours for such receival being from nine to twelve A. M., daily, Sundays and holidays excepted. The deposit is at once sent to the deposit melting room, melted under the supervision of the Superintendent by proxy, who also records the transaction, together with the nature of the gold deposit; it is then re-weighed in the receiving room and assayed without delay. The exact mint value is determined, and upon the following day the depositor receives a warrant drawn on the cashier for payment of his deposit in coin, deductions being made according to the following tariff of charges:

DEPOSIT AND MELTING CHARGE.

On all bullion (or coin) not required to be parted or refined:

For each melt of 1,000 ounces, or less	$1 00
For each melt over 1,000 ounces	One tenth of 1 cent per ounce.

PARTING AND REFINING CHARGES.

1. Parting Gold and Silver or Refining Gold—Rate per Ounce, Gross.

Bullion containing less than 200 M gold	2 cents.
Bullion containing from 200 M to 399½ M gold	3 cents.
Bullion containing from 400 M to 699½ M gold	4 cents.
Bullion containing from 700 M and over gold	6 cents.
Bullion containing over 100 M base metal, additional	½ cent.

And, in addition to the above, on deposits requiring parting (except silver purchases) or refining gold:

For each deposit of 1,000 ounces, or less	$1 00
For each deposit over 1,000 ounces	One tenth of 1 cent per ounce gross.

For gold coin or standard gold bars the rate per ounce charged will be imposed only on the number of ounces required to be refined to raise the whole to standard.

Silver allowed the depositor is calculated on the basis of refining the gold to 990 M.

2. Refining Silver—Rates per Ounce, Gross.

Bullion containing less than 897 M silver	2 cents.
Bullion containing 897 M to 979½ M silver	1½ cents.
Bullion containing 980 M to 997½ M silver	1 cent.

In addition to the above, on silver deposits requiring refining (except purchases) a charge on each deposit of—

1,000 ounces or less	$1 00
Over 1,000 ounces	One tenth of 1 cent per ounce gross.

For standard or sterling bars the rate per ounce will be imposed only on the number of ounces required to be refined to raise the whole to the fineness of such bars.

Silver bullion below 997½ fine, not containing gold, deposited for fine bars, is subject to a refining charge. Silver bullion, deposited for bars, will be computed at $1 per standard ounce. Silver parted from gold deposits will be purchased at the rate fixed by the Director of the Mint, which at present ——— per ounce standard.

TOUGHENING CHARGE.

Gold bullion	½ to 2 cents per ounce gross.
Silver bullion	¼ to 1 cent per ounce gross.

ALLOY CHARGE.

On the number of ounces of copper required to reduce the bullion to standard, 2 cents per ounce, troy.

BAR CHARGE.

On bullion deposited for fine bars not required to be parted or refined, and for standard, sterling, or unparted bars:

Bars of fine gold, per $100 value	10 cents.
Bars of standard gold, per $100 value	10 cents.
Bars of fine silver, per ounce fine	¼ cent.
Bars of standard silver, per ounce standard	½ cent.
Bars of sterling silver, per ounce gross	½ cent.
Bars of unparted bullion, per ounce gross	½ cent.

No deposit of bullion is received of less value than $100, or so base as to be deemed unsuitable for the operations of the mint.

Since the free coinage of silver has been abandoned, the mint receives silver bullion for parting only, returning to the depositor, after the completion of such parting, fine silver bars, for the value of the silver, and coin for the gold that such bullion may have contained, deducting the charges for parting, etc.

The exception to the above being the purchase of silver by the Government to cover the amount of silver coinage per month, as provided for by the "Bland Act." By said Act the silver bullion is purchased by the Superintendent for the Government at the market rates, which are governed by the daily London quotations, allowing for the variation in exchange.

The gold or silver employed for being coined into money is invariably alloyed with copper, and it is enacted that the United States coin shall consist of nine hundred parts of either the gold or silver and one hundred parts of copper in one thousand parts.

The English standard of the alloy is in the proportion of twenty-two parts of either of the pure precious metals to two parts of copper. The basis of silver bullion valuation is sterling, containing 11 oz. 2 dwts. of silver and 18 dwts. of alloy in the troy pound, and assays are there reported as "better" or "worse" than standard in dwts. per pound, according to the excess or deficiency of alloy; the corresponding millesimal fineness is 925 silver and 75 alloy; therefore, 75÷18=4⅙ per 1,000, is equivalent to 1 dwt. per pound; as, for instance, our coin is 900 silver and 100 alloy, is 100—75=25 per 1,000, or 6 dwts. "worse."

Gold with copper forms a ductile alloy of a deeper color, harder and more fusible than pure gold.

Silver that contains 10 per cent of copper is more fusible, harder, and more suitable to friction than pure silver. It is thereby also rendered sonorous, while its color is but little impaired. Even with equal weights of silver and copper the compound is white. The maximum of hardness is attained when the copper amounts to one fifth of the silver.

All the fine gold and fine silver, as also all unparted bullion, is transferred and debited to the melter and refiner of the mint, who is held responsible for all bullion received by him until refined, cast into ingots of standard metal, and transmitted to the coiner.

MOLDING OF INGOTS OF THE ALLOYED GOLD OR SILVER.

The fine gold and fine silver is arranged by weight into distinct melts, for the proper addition of the alloy of copper, and placed in the order of their number. In accordance with the amount of gold these arranged melts contain, they are alloyed with copper, the silver by weight occurring in the fine gold being allowed for as copper, by which means the melts are brought to their standard.

These melts are taken to the gold melting room, where the furnaces have been prepared and the black lead crucibles are at a red heat for the reception of the metal.

In Europe the silver ingot melting is done in wrought iron crucibles, each capable of holding four thousand ounces.

In the crucible some pulverized charcoal is strewn, to neutralize oxidation of the copper of the alloy; a hood is placed over the furnace, through which the bars are carefully placed into the crucibles, as well as the copper alloy. By using the hood, any metal will be prevented from falling into the fire, as a small piece of copper lost would condemn the ingot melt. When the gold bars are melted, further additions are made, consisting of clippings, blanks, etc., which are returned from the coiner's department, until the crucible is about three quarters full. These clippings are made into bundles by placing them in an iron clasp, which in diameter corresponds with the interior of the crucible, and they are introduced into the metal by placing a ring of from three to four inches deep, cut out from another crucible, on top of the melting pot, by which this ring acts as a funnel, as otherwise these bundles, being about nine inches long, would project over the rim of the melting pot, and, as before fusion they become pasty, portions thereof would fall into the fire.

When the metal is in a state of fusion and the temperature deemed adequate, the surface of the metal is sprinkled with very finely pulverized charcoal. This covering tends to the reduction of any oxide of copper formed on the surface of the metal, and the charcoal is allowed to act for a short interval. The charcoal not only assists in the removal of the oxygen, but also prevents absorption of a further amount when the metal is in a state of rest. These are very important facts to be borne in mind in melting for coinage ingots, as otherwise they would be rendered brittle.

To the molten alloy a previously heated stirrer is introduced, and the whole mass is thoroughly mixed by churning the stirrer up and down for quite a time, this being one of the most essential parts of the operation, as the specific gravity of the gold is so much greater than the copper; and a perfect alloying of the metals is here accomplished, so that each and every subsequent ingot cast be of standard fineness. The metal is ladled out and poured into vertical iron molds, each dipper of metal containing two ingots. During the pouring a circular motion is given to the metal in the dipper, so as not to permit the molten mass to subside. The ingot molds are in two sections, slightly varying from rectangular, and composed of three separate pieces of planed iron, which permit of the ingots easily falling out after they are set. Each mold is bound with a clasp, tightened by a set screw. The molds are placed in an iron trough in sets of nine, at a convenient distance from the furnace, and of a height to pour at ease. The metal in the mold solidifies immediately, a workman grasps the mold, throws it upon an iron table close by, when another workman loosens the screw, by which the mold is caused to fall to pieces; he rejoins the pieces, slightly oiling the planed sides, and tightens the molds by the set screw ready for use. This opening and closing is as rapidly performed by the workman as the melter pours into the ingot molds, which pouring, opening, and closing of the molds is continued until a certain quantity of ingots have been poured from one melting pot. Two sets of molds are used, alternating, as otherwise they would become too hot to make perfect ingots.

As each ingot is exposed it is turned into a tray, where another workman, by means of a pair of copper tongs, takes up a certain quantity of these ingots, plunging them hissing into cold water, yet retaining them with the tongs, immersing them, still hot, into a vat containing water acidulated with sulphuric acid, which operation softens and case-hardens the ingots, after which they are again dipped in water to remove the acid.

As soon as one crucible has been emptied of nearly all its contents it is refilled for another melt. The other furnaces containing similar melts are emptied of their contents, one at a time, and the above operation repeated, until all the metal prepared for that day has been cast into ingots.

The crucibles are withdrawn from the fire and the metal remaining in each crucible cast into open molds, which is used upon the following day with new melts.

After the ingots have been washed of their acid, each is placed separately in a vise, and the rough edge trimmed by filing.

From each gold ingot melt, two samples are cut for the assay; one from the first and one from the last ingot cast. These samples are taken to the assaying department, carefully weighed, put up in a slip of paper, marked with the corresponding number of the melt, and assayed. From the silver ingot melts, however, two samples are taken in the shape of granulations, one from the commencement of the pouring, and one when the last ingot has been cast. The ingots on account of their rapid solidification contract in volume and leave a hollow part (saucer shaped) on the top of the ingot. This portion of the metal is cut off by a shears, which is driven by a drum on a shaft of a driving pulley. At each revolution of the drum, the same being excentric, the shears, consisting of a vertically sliding steel jaw, in combination with a fixed steel lower jaw, are caused to open and shut. The hollow end of the ingot is placed therein, cutting off as much as the operator desires.

The weight of a melt of gold ingots averages two thousand nine hundred and fifty ounces, composed of forty ingots for the coining of double eagles, or fifty-six of eagles, or seventy-two of half eagles. The size of an ingot being twelve and a half inches long, one and three quarters inches wide, half of an inch thick for the first, one inch wide for the second, and three quarters of an inch wide for the last.

Each melt of ingots occupies about one and a half hours, including the stirring, pouring, etc.

The melting of gold ingots is not in daily operation, such depending entirely upon the refined gold produced, and when the day is occupied for such purposes from three to four furnaces are run at a time, in which from eight to twelve melts are made.

Each ingot is stamped with a distinctive number to designate the melt, so that if any error should appear the melt can be identified and the composition traced.

The silver, with its alloy, passes through the same stages as the gold.

The average weight of a melt of silver ingots is about one thousand six hundred and fifty ounces, comprising thirty-five ingots for the dollar, the same for dimes, and seventy-two for quarters, the molds being of the same dimensions as for gold, the molds for dimes the same as for the dollars. In the silver ingot melting room there are six melting furnaces, and with three melters and their necessary assistants, thirty-six melts of silver ingots constitute a day's labor, thereby producing about sixty thousand ounces of silver ingots in a day, which is accomplished in about six hours from the time the first silver, with its alloy, is placed into the heated crucibles.

The working variations allowed in the gold ingots is not to vary each way from the standard more than one half of one thousandth, *i. e.*, 899½ to 900½ fine in gold; and the silver ingots, each way, one and one half thousandths, *i. e.*, 898½ to 901½ fine in silver.

The bona fide mechanical loss of bullion incurred in the operation by the melter's and refiner's department, and of the coiner's department, is fixed by law.

The necessary wastage allowed, with the approval of the Superintendent, is, in the case of the melter and refiner, not to exceed one thousandth of the whole amount of gold and one and one half thousandths of silver of the whole amount operated upon, and in the case of the coiner one half thousandth of the gold and one thousandth of the silver of the whole amount operated upon from annual settlement to settlement, at which time the annual clean-up is made, being a most thorough one, covering the receipts of all the residue.

The floors of the melting room in the mint are composed of flagstones, covered with hexagonal castiron gratings of one foot in diameter, having one inch round holes.

As soon as the melts are completed, the sections of iron are removed from the floor proper, from such places where there is any likelihood of metal having dropped, and the floor is carefully swept. The sweepings are vanned and the recovered grains dried.

The ingot melts are taken to the melter and refiner's room, where each melt is weighed; the weight is registered in the day-book, and at the end of the day the surplus assay clippings, sweeping grains, filings, and residue bars, are added to the amount of the ingots, so as to show the apparent waste that has taken place. The ashes and cinders from melting the gold ingots, or those of the silver ingots, are ground up, and at the close of each month are cast into a bar and credited to the ingot account, gold or silver.

The ingots are locked up in the melter and refiner's vaults, and remain there until such time as the assay trials have been made and an order for delivery on the coiner transmitted. This being done, they are sent to the office of receipts, weighed in the presence of the proper officers, and a receipt there given to the melter and refiner by the coining department. On the other hand, when the melter and refiner receives clippings, blanks, and other pieces of metal from the coining department, he gives a receipt therefor to the coiner.

Seven twelfths of the ingots is the amount of good coin produced, minus the ends cut off, including all hollow, brittle, or badly melted ingots; consequently the amount returned to the melting department should not exceed five twelfths. Any amount over five twelfths of clippings, etc., returned is to the prejudice of the melter, as by carelessness or indifference of interest displayed by the melters this amount is liable to be larger, by which naturally the expense of coinage is increased.

Upon the reports of the assays proving satisfactory, the ingots are delivered as above described for coinage, condemning, however, such melts as are found to deviate from the standard beyond a certain amount. These are either remelted, with some addition of alloy or fine gold, or simply combined, melted, thoroughly stirred, and cast into ingots.

The ratio of condemned melts of gold and silver ingots is in none of the mints large, of which the San Francisco Mint has produced the best record.

THE ALLOY OF THE REFINED METALS.

The copper employed for alloying purposes is of the very best grade from Lake Superior, refined at Baltimore, Maryland. Its fineness is nine hundred and ninety-nine and seven tenths, the remaining three tenths consisting chiefly of iron.

It is the practice at some mints to remelt the copper for the purpose of subdivision, as well as for the convenience in making up the ingot melts. The copper in this case is melted in plumbago crucibles, and when it is in a proper condition for removal from the furnace it is cast into a series of small molds (previously oiled), arranged along the side of the furnace. As soon as the copper has solidified in the molds, it is turned over to the edge of a water tank, and with a smart shock the small slab of copper is thrown into the water, by which the oxide of copper formed on the face of the slab, during the momentary cooling upon settling, is removed. The remelting of the copper, unless skillfully accomplished, renders the copper brittle. No charcoal dust is used on the molten copper, as it would become "overpoled." In case the latter takes place the molten copper must undergo a short exposure to the oxidizing influence of the atmospheric air.

The pouring must be effected at a high heat, as the metal chills very easily in the crucible, and must be executed with the least possible delay, since it would otherwise be liable to again become somewhat "dry" through the absorption of oxygen, rendering it brittle, in which case some charcoal must be added, which tends to the reduction of the oxide formed, allowing the charcoal to act alone for a short interval. But if too dry, "poling" must be resorted to with a pole of green wood, by which copious gases are evolved, and the reduction of the oxides is rapidly completed. This "poling" also prevents the further absorption of oxygen while in a state of rest. The surface of an ingot of tough copper is almost level; if impure it sinks into a furrow or rises into a ridge.

In concluding with the melting and refining department it may be well to state that in some mints the Reichhelm gas cupel furnaces have been introduced, in which the work is satisfactorily conducted, and it is but a mere question of little time when gas furnaces will be in operation for the melting of the precious metals, the preference for which is clearly perceptible.

THE COINAGE OF THE PRECIOUS METALS.

Coinage is the act of fabricating money. In the departments of the coiners of the mints the gold and silver ingots received undergo nearly the same operation. For this reason a description of one will suffice for all; nor in such description is any one particular mint referred to, but a summary of all, endeavoring to illustrate their methods combined in one. The ingots are weighed by the transfer clerk, in presence of a clerk of the melter's department and the receiving clerk of the coiner's department, by which manner the accounts are checked, and are delivered into the coiner's office. A tag is placed on each set, and they are next conveyed to the rolling room, where they are subjected to flattening and laminating.

THE ROLLING OF THE INGOTS INTO FILLETS.

The rolling room contains several sets of rollers, large and small ones, composed of break-down and finishing rollers. The rolling mills are driven by geared pulleys, receiving their power from the main driving shaft and pulley, which drives a shaft and adjusting couplings of the rolls.

The pressure of the rolls varies as to the size of the rolling mill, as for the first break-down rollers the pressure being about eighty tons. These rolls are generally made of chilled caststeel, with a face about twelve inches long and eight inches in diameter, to which the gudgeons are cast solid. Each roll is driven independently by its own pulley in opposite direction. The boxes of the journals are made of brass, of which the lower half is provided with babbitt metal gibs, extending to the full length of the bearing portion.

The limit of play between the rolls is regulated by the action of a lever, which gives motion to screw wheels on top. Below these screws, cups are attached, which rest on the upper brasses of the journal of the roll, by which means the upper brasses are always against the end of the screw. The contrivance, therefore, is such that the upper roll alone has an upward and downward, as well as its revolving movement, the lower roll revolving simply on its axis. The speed of the rolls is about eighty revolutions per minute, and are driven by a pulley five feet in diameter with a ten-inch face.

The distance required between the rolls is arrived at with the utmost precision by a steel instrument, which is attached to the mill by a clamp, which has the appearance of a hollow wedge, and indicating by a gauge thereon the distance of the opening of the rolls.

The ingot is placed on a lateral guide, such being attached to the feed side of the mill, where it is bitten by the rolls, dragged forward and passed through to where they fall on the discharge side upon flat guides, preventing any flexure of the passing ingots. In this manner each ingot of a set is passed through the roll, and as the rolls were set by the gauge, described above, the first rolling merely compresses the ingots.

The rolls are now adjusted by the screws, set by the gauge, by which any further upward motion of the top roll than required becomes impossible, and the ingots are again passed through the rolls. The rolls are again reset, and the rolling goes on until each ingot has passed through several times at varying pinches, until they have assumed the desired thinness for passing through the breaking-down mill, the ingots having reached a length of about three and one half feet, by which means the now termed "fillets" retain a nearly uniform thickness. A continued rolling causes the fillets to become thicker in the middle than on the sides. The rolling, however, does not increase the width of the fillets to any perceptible degree, for the reason that the decrease of thickness is proceeded with by gradual pinches of the adjusting screws.

The fractured ends of the fillets are removed by a cutting press, similar to those in the melting room heretofore described.

ANNEALING OF THE FILLETS.

After the shearing the fillets are transferred to the annealing room, as by continuous rolling without annealing they become hard and brittle, making them liable to crack at the edges, which would seriously interfere with the subsequent operations.

In the annealing room there are several reverberatory furnaces, all of the same size and character. They are built of common brick, lined with firebrick, held together by heavy castiron frames. Heavy castiron doors about one foot square are attached, the fire chamber being about eighteen inches high, the furnace hearth five feet and nine inches long and fourteen inches wide, the wood fire being regulated by dampers. In front of the working door an iron carrier, resting on an iron bench attached to the furnace, is placed.

The sheared fillets are placed in copper tubes of three sixteenths of an inch in thickness, three feet ten inches long, and four and one quarter inches in diameter; each tube will hold from twenty to twenty-five fillets. These tubes are made without solder. The annealing is accomplished at a high degree of heat.

The tubes, containing the fillets, are capped and luted with pipe-clay, placed upon the carrier, and run onto the hearth of the furnace. The doors are closed, the dampers opened, and the heat raised to the annealing point, which is left to the judgment of the workman. The annealing will be completed in about twenty-five minutes, the utmost care being exercised that the heat is equally distributed, as well as occasionally turning the tubes over. The fillets, so inclosed from the atmospheric air, prevents the oxidation of the copper with which they are alloyed, for should such take place it would render the subsequent coin above standard.

As soon as the annealing is completed, the dampers are lowered, the working door raised, and the carrier pulled out onto the stand. The tubes are removed from the carrier by iron tongs and immersed in rectangular copper-lined vats; the caps, after a few minutes, are removed, whereby the tubes fill with water.

The fillets are now removed, cleansed in acidulated water, rinsed in water, and dried with cotton cloths.

This mode of rapid cooling is resorted to to prevent the access of the atmosphere, as prolonged and open cooling facilitates the absorption of oxygen.

ROLLING OF THE ANNEALED FILLETS.

The fillets are now returned to the rolling room, and are passed repeatedly through the breaking-down mill with what is termed a "spring pinch," as in the previous rolling they were also a trifle thicker in the middle than on their sides.

In the drawing out of the fillets it sometimes happens that they separate into two layers, more so in the silver than in the gold fillets, which is due to the imperfect mixture of the alloy in melting previous to being cast into ingots.

The inner surface of the fillet will be coated with a thin film of copper, often quite pure, but more frequently in form of a suboxide. From this it appears that a globule of copper is enveloped in a volume of the fluid silver or gold, and during the pouring of the metal into the ingot it is drawn out into a wire. During the subsequent rolling a slip is caused, as otherwise there will be no adhesion between the surfaces of the flattened metals.

FINAL REDUCTION OF THE FILLETS IN THE GAUGING MILL.

The final reduction of the fillets to a uniform thickness is completed in the gauging mill, which differs somewhat in construction from the break-down mill. The upper roll of the gauge mill is held by brasses loosely clamped together, the upper brasses being bolted with set screws in the frame of the mill, the lower brasses being supported by spiral springs, which also support the upper roll when the mill is not being fed. The lower roll runs on a wedge-shaped brass, resting against another wedge-shaped brass, which wedges when closed represent a solid square. Against the wedged brasses, upon which the lower roll runs, a screw is set to adjust these wedges, which screw receives its turning from a crown and pinion wheel; the wedge is worked forward and backward by the adjusting of the screw. As the fillet passes between these rolls, the proper thinness being here likewise gauged by a scale on a steel instrument attached, the top roll presses against its upper brasses, which impedes any further rising of the roll, and by the adjusting of the bottom wedge by means of the screw the requisite space between the rolls for the passage of the fillets is retained. Upon each adjustment a difference of 0.001 of an inch in thickness can be made upon the fillets. The last rolling of the fillets, however, is completed without any pinch, so as to reduce them to one uniform thinness.

ANNEALING OF THE REDUCED FILLETS.

The very long fillets are now cut into two equal strips by the shearing machine. To prevent the metal becoming brittle they are again annealed in the furnace. The annealed fillets are introduced into a steam chest, which is made of wood, lined with sheet copper, about four and one half feet long, two feet wide, and one and one half feet deep, to which hinged covers are attached. Steam pipes are introduced into the chest, by which the water is raised to the proper temperature, which is about 180 degrees Fahrenheit, into which the annealed strips are introduced, and are kept at this temperature for about ten minutes. The steam is then shut off, and the water allowed to cool; in about one hour the gold fillets are removed and covered with melted wax. The silver fillets, however, are subsequently dipped in tallow.

THE STUBBING OR FLATTENING OF THE FILLETS.

The fillets are taken to the cutting room, where one end of each is trimmed square by a small shearing machine. The next operation is to pass them through the rolls of a stubbing mill. This apparatus consists of small rolls of castiron of three inches in diameter, with a two-and three-fourths-inch face. The lower roll is a plain cylinder; the upper cylinder is beveled, with three faces, whereby its periphery has three rounding and three flat surfaces. When the rolls are set revolving, spaces with openings are made, and as the revolving continues the openings narrow as the rounding face comes down, whereby the ends of the fillets placed therein are "stubbed" or flattened, which flattened part will be reduced to about two thirds its thickness. The distance between the faces of the rolls is adjusted by hand screws on top of the mill.

The end of each fillet is passed into the space of the rolls, which shapes two inches of each strip so as to render that end to the required thinness of admitting it into the orifice of the next machine, called the draw-bench. During the stubbing the fillets rest on a movable guide attached to the mill, and as they are expelled (caused by the revolving of the rolls in opposite direction) they pass into a trough, from which they are conveyed to the draw-bench for final adjustment.

COMPLETION OF THE FILLETS IN THE DRAW-BENCH.

The draw-bench in construction is similar to that used in wire works, designed, however, for flat drawing. It consists of two adjustable castiron rolls, set vertically and revolving in opposite directions, through which the stubbed end of each fillet is passed. The flattened part of the fillet is of the requisite thinness to admit of its passing easily between the cylinders until seized by the teeth of the dog; as soon as that part which was not previously flattened comes against the rolls, the drawing of the fillet commences, requiring much force to drag it between the cylinders to the discharge side, and to reduce it to that exact uniform thinness necessary for "planchettes." As the fillets pass through the draw-bench they are cut into two lengths by the shears attached to the bench. The rolling of the strips is completed by the draw-bench, which began by the large rolls upon the ingots in the rolling room.

THE CUTTING OUT OF THE FILLETS INTO PLANCHETTES OR BLANKS.

The cutting-out presses are run by excentrics on a counter-shaft, to which a series of cams are attached, thereby raising and lowering the shaft of the press; and as it raises the fillet is placed on the bolster, the cutter descends, cutting a "blank," which falls through the bolster into a drawer beneath; as the cutting-out punch rises again, the fillet from which the blank has been detached comes against a guard, which detaches the fillet. A gauge is connected with the press to test any irregularity of diameter and thickness of the blank that may have taken place, which could not be detected by the weight alone.

The fillets, one by one, are passed to the cutter, who cuts two blanks out, one from the first end and one from the middle, thus continuing with the set. Each trial blank is then weighed, on a delicate balance, to ascertain their correctness, and each strip thus proven is cut out into blanks. Should any of the trial blanks prove too heavy, the fillets from which such have been cut are either passed once more through the draw-bench, or, if necessary, with a spring pinch through the gauge mill; if too light, they are adjusted by the cutting-out punches, in altering the diameters of the punch to a very slight extent, or they are cut by a concave punch, so that the lighter blank cut out is thereby rendered by weight to the standard blank. The fillets which are properly cut are carried to the cutting-out press, where they are cut into blanks and scissels.

The blanks are frequently examined to see that the edges retain their smoothness, as the cutter or bolster may fracture the edges, by which a loss of weight is entailed, thereby rendering them unfit for use, and for this reason also the trier, at frequent intervals, sets the weights of a given quantity of blanks, which process is termed "pounding." The blanks are also rung to detect any which may be dumb or cracked. The detached fillets are now the so called "chippings" or "scissels," which have the appearance of long ribbons perforated with round holes. There will be about 60 per cent of planchettes produced from the original weight of the ingots.

CLEANSING OF THE PLANCHETTES OR BLANKS.

The planchettes, as well as any condemned planchettes, and the clippings, are conveyed to the cleaning room, where they are boiled in a solution of potash to remove the wax and restore them to their brightness, and then transferred to the adjusting room. The condemned blanks, chips, and clippings are returned to the melting department through the transfer clerk, in the same manner that the ingots were received.

THE ADJUSTING OF THE PLANCHETTES.

The adjuster tests each planchette on a pair of test balances, and if they prove of standard weight, including the working allowance, are passed, but checked by re-weighing.

If the gold planchettes are too light, they are condemned; if too heavy, they are reduced to their prescribed limit by filing the rim by hand, which is done by drawing the rim lengthwise over a file, whereby the uniform circumference is retained.

The silver planchettes that are too heavy are not adjusted by hand, but filed by lathes in the coiner's weigh room.

The standard planchettes are weighed once more, to insure complete accuracy, and are made up into drafts to be taken to the coiner's room and weighed; the condemned ones are set in drafts and likewise conveyed to the coiner's room, weighed, and transferred with the other clippings to the melter's department.

The legal tolerance in weight of light or heavy planchettes allowed on double eagles and eagles is one half grain, for half eagles one fourth grain, and for silver dollars one and one half grains. The limit of working tolerance is one tenth grain on the standards and three tenths grains on the light planchettes.

THE COMPRESSING OF THE PLANCHETTES.

The drafts of planchettes are transferred to the press room for the compressing of their edges in the "edge compressor." The planchettes are placed in a tray hopper attached to the compressor and supported by a rod. The compressor is driven by a pulley, which, from a reduced pulley, sets a disc with a groove in motion on the main block of the compressor, which reduced pulley sets also another pulley, cut with notches, in motion. As soon as the driving pulley is started the blanks gradually fall into a tube at the lower end of the tray, where they rest against the notched pulley, and as each notch passes the tube it carries with it a planchette, from whence it is carried into a slide, thence conveyed with some force into a narrow groove of the block of the compressor; said block communicating with the same proportionate groove of the revolving disc. The planchette is finally here caught by the revolution of the disc and grooves, from whence, after two revolutions, the edge is compressed and the planchette falls into a tray. The planchettes by this operation are reduced in diameter, but are thicker on the edges, with the center retaining its dimension, which compression of their edges prepares the blanks for the "crenating" or "milling," which crenating is given by the collar of the die press.

One of these edge compressors can be fitted for blanks of any dimensions, if provided with reciprocal blocks and discs, which can be adjusted in a very short time.

WHITENING AND ANNEALING OF THE PLANCHETTES.

The blanks are sent to the "whitening" room, where they are cleansed in copper pans, by washing in hot water with soap and soda and afterwards rinsing in boiling water.

After drying the gold blanks are placed in copper tubes, luted with fire-clay and annealed rapidly, until the tubes attain a full red heat, the time consumed for this operation being from fifteen to twenty minutes. They are then withdrawn from the furnace, and placed on the floor to cool; then immersed in wooden vats containing hot water slightly acidulated with nitric acid, the latter removing the slight discoloration on the surface of the blanks, caused by oxidation. The silver blanks are annealed in open copper vessels, then immersed in a lead-lined vat, containing hot water acidulated with sulphuric acid. The blanks are well stirred in the pickle in which they remain for about five minutes, after which they are rinsed with boiling water, shaken with basswood sawdust, dried on a steam bath in open pans, being stirred the while with wooden rakes. The blanks are again weighed and taken to the press room for coining.

THE COINING OF THE PLANCHETTES.

The larger presses are used for double eagles and standard dollars; the smaller for eagles, half eagles, and subsidiary silver. The largest press in the San Francisco Mint has a pressure of about one hundred and seventy-five tons, and turns out about eighty coins per minute. It is claimed that one of the presses at the Carson Mint is the most powerful in the world, requiring five horse-power to drive it.

The planchettes are conveyed to a tube connected with the press, and by an automaton hand, when the press is brought into motion, a planchette is laid from the tube onto the lower die of the coining press. As the automaton hand retires, the collar around the lower die rises and encircles the blank, while the upper die held in the block of the driving stem comes down with a square blow on the blank with great force, converting the blank by one stroke into a perfect coin, giving the relief and depressed impression, as well as the crenated edge. The blow forces the metal into every engraved part of the collar and die. When the day's coining is completed, the dies are taken from the presses and placed in the mint's vault.

THE PYXING PROCESS OF THE COIN.

The coin is returned to the weighing room, weighed and examined, where the breakages are picked out and condemned. The coins now undergo the "pyxing" process, technically so called, by which the weight and fineness of the coined money is determined before it is delivered to the public.

It consists in taking from every journal weight of gold or silver coin a pound, which is weighed on an accurate balance, the plus or minus weight being detected by the weigher, and recorded by the clerk. This determines whether the coin comes within the limits allowed by law.

From the pound weight of gold or silver coin, pieces are taken by the cashiers, in the presence of the Superintendent, in number provided by law, who weighs them with his standard weight. Two pieces are next selected, the one to be assayed in order to test the fineness, the other for subsequent examination at the general trial of the "pyx."

This "pyx" of reserved coin is sent to Philadelphia, to be examined and tested for the weight and fineness of the gold and silver by the Assay Commissioners, who are appointed for that purpose.

The condemned coins are broken, reweighed, and melted in the melting department with the clippings as before described. The filings, dust, and other substances that are liable to contain any metal are put aside until the annual settlement.

When the assay trial proves the coin to be of the legal standard, and the weight is within the legal limit, it is accepted, and the Superintendent authorizes the money to be delivered for circulation.

THE METHOD OF MAKING THE DIES.

An original die is engraved upon a piece of soft caststeel of the same size as the money to be coined. The design is cut into the steel, and its depth is proportionate to the relief required upon the coin. After the finishing of the engraving, the matrix or die is hardened. If the die proves to be perfect it is placed in the multiplying press, which works in every particular like the coining press, but is moved by hand. An impression is taken from the matrix upon a blank die of cast steel, in the same manner as impressing the coin. The blank die is fixed as the lower die of the coining press, and by working the screw of the press by means of the long and heavily loaded arms, the matrix, as in coining, strikes the blank with a blow of great force, whereby the relief impression is brought upon the surface. The hardness, by compression, of the steel is so great that a perfect impression of the engraving cannot be at first obtained, therefore the die is annealed in an iron shell with animal charcoal, which annealing may have to be repeated two or three times, and after being gradually cooled it is again subjected to pressure, and so on until the impression is satisfactory. By obtaining the impression in the manner described it is called a "puncheon die." When the engraver has made all the delicate touches of the original to it, it is also hardened in the manner as before described, and is used to give impression to blank dies by a similar process; here, however, the impression is sunk, whereas in the other it was in relief. Such are the dies employed in stamping the blanks into coin.

The puncheon by which the die is stamped is of hard, and the blank die is of soft steel. The process of hardening is effected in a castiron shell furnace, lined with firebrick. The puncheon is heated for about an hour; then placed in a brass holder composed of two parts, with a screw clamp for securing the puncheon, and provided with a socket, into which a water pipe is screwed. The water is turned upon the puncheon with great force for about three to four minutes, thereby rapidly chilling the steel. The puncheon is then removed and dried.

The softening is effected by placing the dies in a vessel covered with animal charcoal, allowing them, after annealing, to gradually cool in the closed vessel.

The blank dies are formed of cylindrical pieces of nicely turned and polished steel, of which one end is conical shaped, the other end being square. After the press has given the first blow, whereby the first visible impression is effected, the cone disappears. The die is then taken to a turning lathe to shave off the rim of metal formed round the impression, which then permits, after again annealing as previously described, the next blow of the press to deepen the impression without spreading the steel. These blows, annealing, etc., are repeated till a perfect die is obtained. The durability of the dies varies exceedingly, depending on the quality of the steel, as well as the character of the metal to be stamped, which differs in hardness or softness, according to the nature of the alloy contained in it.

It is requisite that the dies and collars employed in stamping the coins should be frequently tempered to retain their hardness. The rolls of the rolling mill, likewise, will require to be taken apart whenever they begin to wear irregularly, and turned with emery upon the lathe. The dies are also frequently dressed by an emery wheel, in order to retain the bottom perfectly smooth and even.

An accurate register is kept of all dies manufactured, as well as an accounting of all matrices, puncheons, and dies destroyed, so that none can be surreptitiously used or carried away.

TABULATED STATEMENT OF UNITED STATES COINAGE.

DENOMINATION.	Authorized by an Act of—	Weight, in Grains.	Fineness.
Half eagle	April 2, 1792	135.	916$\frac{2}{3}$
Eagle	April 2, 1792	270.	916$\frac{2}{3}$
Double eagle	March 3, 1849	516.	900.
Standard dollar	April 2, 1792	416.	892.4
Half dollar	April 2, 1792	208.	892.4
Quarter dollar	April 2, 1792	104.	892.4
Dime	April 2, 1792	41.6	892.4

DENOMINATION.	Change in Weight, by an Act of—	Change in Fineness, by an Act of—	Diameter, in Twentieths of an Inch.	Thickness, in Thousandths of an Inch.
Half eagle	June 28, 1834, to 129 grains	Jan'y 18, 1837, to 900.	17.	0.046
Eagle	June 28, 1834, to 258 grains	Jan'y 18, 1837, to 900.	21.	0.060
Double eagle			27.	0.077
Standard dollar	Jan'y 18, 1837, to 412½ grains	Jan'y 18, 1837, to 900.	30.	0.082
Half dollar	Feb'y 12, 1873, to 192.9 grains	Jan'y 18, 1837, to 900.	24.	0.057
Quarter dollar	Feb'y 12, 1873, to 96.45 grains	Jan'y 18, 1837, to 900.	19.	0.045
Dime	Feb'y 12, 1873, to 38.58 grains	Jan'y 18, 1837, to 900.	14.	0.032

THE AURIFEROUS GRAVELS OF CALIFORNIA.

GEOLOGY OF THEIR OCCURRENCE AND METHODS OF THEIR EXPLOITATION.

By JOHN HAYS HAMMOND, E.M.

Prior to the gold excitement in California and Australia in the years 1848 and 1851, respectively, the estimated quantity of gold in circulation in the world was from $2,000,000,000 to $2,500,000,000. Since the commencement of this golden era, it has been computed that the world's gold circulating medium has been increased by the introduction of about $4,500,000,000.

The great part California has played in the addition to the world's wealth will be recognized when it is said that fully one quarter of this increase has been derived from the gold mines of that State. Of the entire gold production of California, not less than nine tenths has been yielded by the "auriferous gravels."

The total yield of the auriferous gravels of California would be represented by the value of a cube of pure gold having an edge of fourteen feet. Over $100,000,000 have been invested in the gravel mines of California.

The auriferous gravels may be divided into two classes:

First—The shallow or modern placers.

Second—Deep or ancient placers.

These terms are indicative of the very characteristic difference that exists between the two classes of placers.

THE SHALLOW OR MODERN PLACERS.

The signification of these terms will be apparent from an explanation of the origin and mode of occurrence of the placers. These placers are superficial accumulations of auriferous alluvions along the gulches, bars, flats, etc., and are designated gulch, bar, or flat diggings, according to their topographical position. The deposits along the modern rivers belong to the shallow placers.

The gold-bearing detritus of which they consist has been derived from the ancient placers or the quartz veins; in some instances, from both sources. Through the disintegrating and transporting power of the meteoric agencies, especially of running water, the material has been brought from the above sources, and redeposited in places of lower elevation, where it was discovered by the pioneer miners. Thus the assorting process has been carried, by natural agencies, one step farther than in the case of the deep or ancient placers, and two steps farther than in the formation of the gold-

---

The relative costs of working the various classes of gold deposits by methods applicable to the respective classes are:

1. Auriferous vein	$3 to $10 per ton material treated.
2. Drift mining	75 cents to $4 per ton material treated.
3. Miner's pan	$5 to $8 per ton material treated.
4. Rocker	$2 to $3 per ton material treated.
5. Sluices	75 cents to $1 per ton material treated.
6. Hydraulic method	1½ cents to 8 cents per ton material treated.

bearing quartz veins. To this process of the higher concentration of the gold is due the extraordinary richness of the shallow placers.

From the shallow placers, and from the beds of the modern rivers, came nearly all the gold produced by California up to the year 1854, and indeed the larger percentage up to the year 1860. The exhaustion of the gold gravels, capable of being worked with profit by such primitive means as were available at that time, led to the abandonment of the shallow diggings.

The unworked deposits, also, often occur below the drainage level.

The pan and cradle, especially the former, are still used for the purpose of "prospecting" or testing the gravel, and for cleaning up the sluices, batteries, etc., at all mines. The accompanying illustrations of these articles suffice to describe them.

The batea is better than the pan for purposes of prospecting gravel or quartz. It is used extensively in South America, Central America, and Southern Mexico. It consists of a shallow wooden bowl, from twelve to twenty-four inches in diameter and of two to four inches in depth from the center depression to the level of the rim. It should be colored black (by paraffine paint) to show the collected gold more readily. The pan is, however, preferable to the batea for cleaning up the sluices, etc.

The flat character of many of these deposits preventing the attainment of the grade requisite for "sluicing" and of the "dump" for the disposition of the tailings, enhances the difficulty of working alluvions of this class. To overcome these difficulties mechanical contrivances of various designs (hydraulic elevators, etc.) have been introduced in some places with considerable success.

River mining by sluices, rockers, etc., is now almost entirely limited to the operations of the Chinese, several thousand of whom, scattered over the State, follow the business in a desultory way. A few of the bars of the present rivers are still being worked by "wing dams," by which at periods of low water the river is diverted to one side so as to leave dry the gravel deposit. "Chinese" pumps are used in this class of mining to drain the deep holes from which the water has not receded after the deflection of the river.

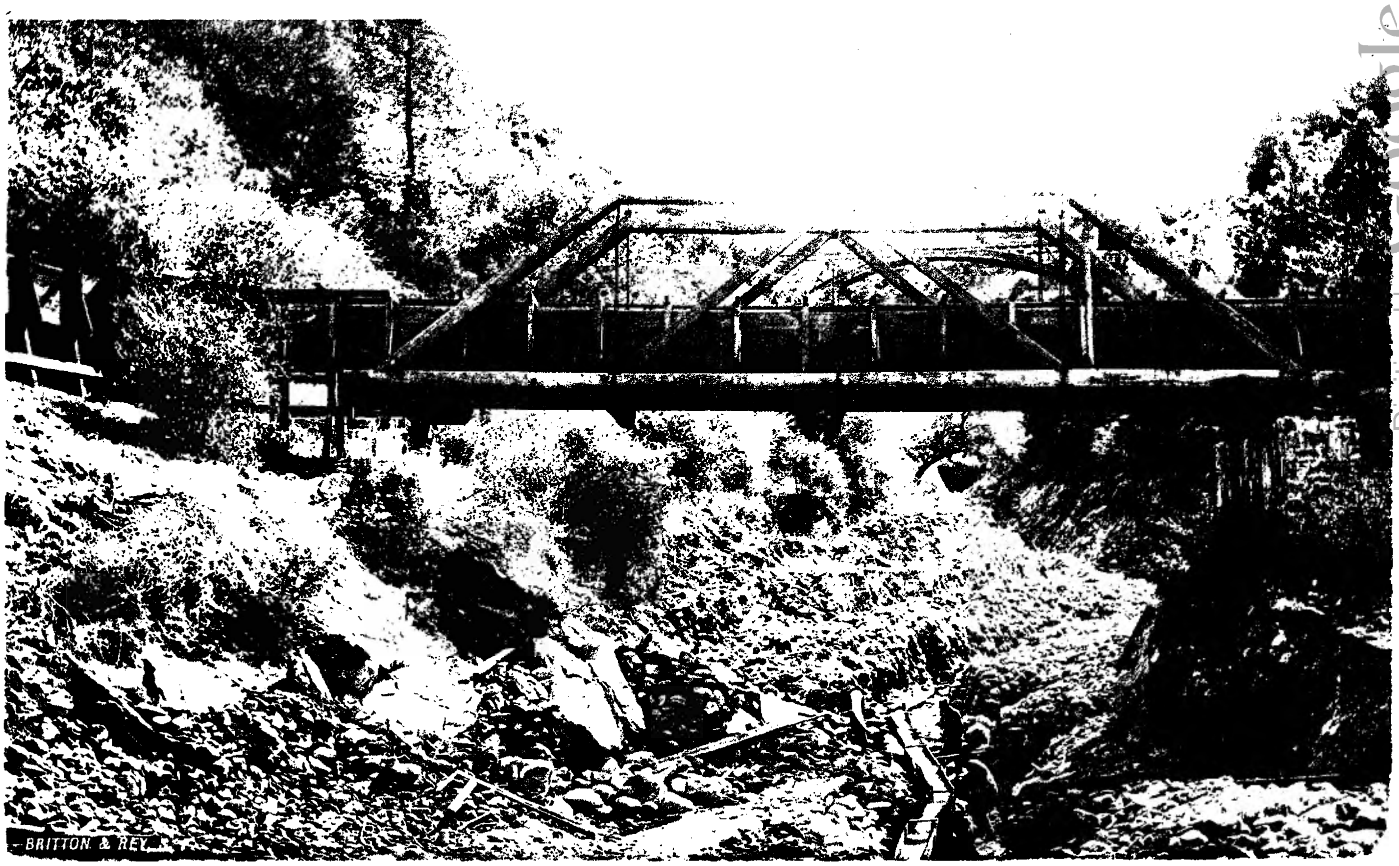
In several localities, Butte and Placer Counties principally, plans are being carried out to work the beds of rivers reputed to be rich by constructing head dams, by which the water is diverted into large flumes, which carry it below the point to which it is designed to extract the gravel. This system involves considerable expense, and is usually attended with great uncertainty as to the success of the enterprise.

Dredges are used in a few localities where gravel occurs below the drainage level of the locality to elevate the gravel to a horizon sufficiently high to obtain the requisite grade for sluicing and for the dump.

Under similar topographical conditions "hydraulic elevators" are used. The modus operandi is as follows: The material piped from the bank is carried by the water into an excavation into the bedrock, at which point is placed the lower end, made flaring, of the pipe through which the gravel is to be raised to the sluices, which are set on the level of the upper end of the pipe. A stream of water, under high pressure, is played through a nozzle into the lower end of the pipe just described, and the gravel washed by the swiftly ascending current upwards through the pipe to the point of efflux into the sluices.

This method materially aids the disintegration of the gravel, wherefore a shorter string of sluices than ordinarily used will suffice. Artotype No. 4 shows the elevator used at the North Bloomfield Mine. The capacity of this elevator is, according to Superintendent Radford, two thousand four

MODE OF USING PAN AND CRADLE.



1. Gulch Washing.—The coarse rocks are piled to one side, while the fine dirt is shoveled into the narrow sluices seen in the picture.
2. Truss Bridge, for carrying flume.

hundred cubic yards per twenty-four hours. The gravel is elevated eighty-seven feet vertically. One thousand three hundred miner's inches of water are required under a pressure of five hundred and thirty feet. In addition to elevating the gravel, the eight hundred inches of water used in piping the two thousand four hundred cubic yards of gravel is also raised with the gravel.*

The gold-saving apparatus of the shallow placer mine—the pan, cradle, tom, sluice, etc.—are now objects of hardly more than historical interest. From their nature, as compared with the illimitable resources of the deep placers, the shallow diggings, as a source of gold, will be but of a transient character. The virtual exhaustion of the superficial gravel deposits gave origin to that "prospecting" for the source of gold which resulted in the discovery of the deep placers and of the quartz veins.

From these discoveries dates the inauguration of mining as a scientific and permanent industry in this State.

EFFECTS OF EROSION.

The erosive power of flowing water is strikingly manifest in the stupendous denudation that has been effected through its agency on the western slope of the Sierra Nevada Mountains. In a very recent geologic time the entire relief of its western slope has been changed. Mountain ridges that were hundreds, and indeed thousands of feet in height, have been utterly obliterated by erosive agencies, while the present elevated position of the deep gravel channels shows how energetic has been the operation of these elements.

The prevalent topographical features of the gravel epoch have been in many instances inverted, and that which constituted the prominences of that age has been, by the resistless erosive power of water, converted into the depressions of to-day.

The detrital accumulations of the gravel epoch thus stand out in bold relief in the topographical features of the western slope of the Sierras, and are everywhere conspicuous objects in the panorama.

As early as 1851, Mr. T. P. Tyson, writing upon the geology and industrial resources of California, noted the existence and described the character of the gravel formation he had seen on his trip (in 1848) through the central mining counties.

THEORIES OF GENESIS OF "ANCIENT RIVERS."

Other travelers followed Mr. Tyson, each with his "theory" as to the genesis of the auriferous gravel formation, and it may be of interest to review a few of the more widely entertained of these theories, especially as some of them have not yet been wholly eradicated from the popular mind.

The "marine theory," which referred to the formation of the gravel deposits to the action of the sea, was, for many years, the most popular of the hypotheses evolved to explain the phenomena connected with the auriferous gravels.

The palæontological evidence on this point is most unequivocal. The absence of massive fossils on the one hand and the presence of remains of terrestrial life on the other hand, are not only a most conclusive refutation of the "marine theory," but a positive proof that these deposits were of a subaerial origin. Other considerations (the distribution of the deposits, the character of the component parts of the formation, the remains of what were unmistakable portions of the banks of ancient rivers—the rim-rock, etc.) impel one to the above expressed conclusion.

---

* Since writing the above I learn from Mr. L. L. Robinson, the President of the North Bloomfield Company, that the hydraulic elevator has been abandoned because of the great expense attending its operation. He thinks, however, that for heights up to about forty feet the elevator would work to advantage under favorable conditions, as to cost of water, etc. The company is making other experiments in this direction at present.

The "glacial" theory was one which, for awhile, had many advocates. It finally lost its prestige when geologists conversant with glacial phenomena began to investigate this subject. The absence of the "bowlder clay" of the glacial striations, and of the rounded hummocks (called "roches mountinnées") is negative evidence regarding the glacial theory. Per contra, the character of the bedding, the sub-angular and rounded bowlders, show that water, not ice, has been the transporting agent in the accumulations of the auriferous gravels.

At the time Whitney began his examinations the "fluviatile, or deep river theory" had already many adherents. But, with this theory, was unfortunately connected the blue lead theory; or more accurately speaking, the "fluviatile" theory was embodied in the latter, which received the support of many geologists.

This (blue lead) theory supposed the existence of an ancient river flowing from the northeast to the southwest, and having its general course parallel to the crest of the Sierra Nevada Mountains.

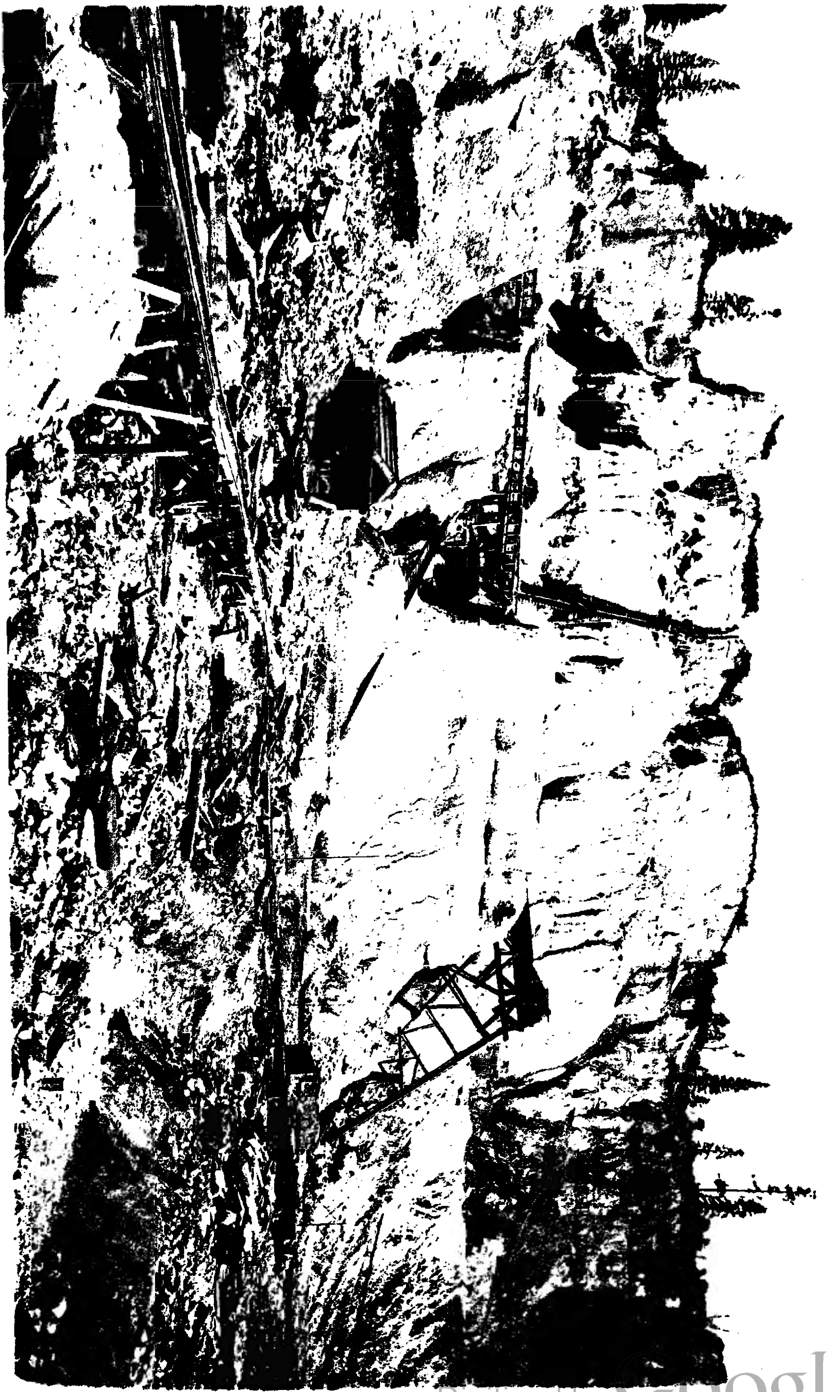
The theory derived its name from the bluish color of the gravel filling the channel; and the adherents of this theory profess to be able to identify and to coördinate with the blue lead, by means of this characteristic color, isolated bodies of gravel in various portions of the State. The detailed examination of the geographical positions of the old river channels and their outliers has shown that no river or system of rivers followed this course in the gravel epoch, and the very foundation of the theory was thus destroyed. Furthermore, to this theory, as Mr. Goodyear says, exists the insuperable objection that its acceptance involves the assumption of an uplift or elevation of the Sierra Nevada Mountains, subsequent to the gravel epoch, to account for the change in the present system of drainage with reference to the system of drainage existing during the gravel period. That no such oscillation of level has occurred since the deposition of the deep gravel is, in the writer's judgment, susceptible of proof by the study of the structural geology of the Sierras.

Furthermore, that there is no necessary connection between the bluish color of the gravels and the source from which the material has been derived, will be demonstrated in connection with the discussion of the materials filling the channels.

The blue lead theory, like the glacial and marine theories before it, has now been generally discarded by the investigators of the auriferous gravels, and there has been generally accepted the "fluviatile" theory in its essence, ascribing the origin of the gravel accumulations to the depositions of ancient rivers with courses similar to the present rivers. The character of the deposits show that there has been an intermittent action. The torrential period and the quiescent period are both shown in alternating heavy and light material of the channels. But while there is this unanimity of opinion as to the origin of the gravel accumulations, there still exists a difference of opinion regarding the geological age of the deposits.

GEOLOGICAL AGE OF THE ALLUVIONS.

Authorities differ as to the age of these deposits. Whitney refers them to the tertiary (pliocene) period, while Le Conte assigns them to the qua-



HYDRAULIC ELEVATOR, BLOOMFIELD MINE.

ternary age. The palæontological evidence probably favors Whitney's classification. It is certain that the predominant flora and fauna are tertiary, but it is not impossible, Le Conte insists, that this pliocene life has lingered into quaternary time.

The mastodon is distinctly pleistocene, and remains of mastodons have been found in the deep river gravels.

MATERIAL FILLING THE CHANNELS.

Lava.—This may be a true lava, brought into its present position by a lava flow, or, as more generally is the case, the term refers to lava of a fragmental and tufaceous character. Lava bowlders are more or less rounded, water-worn bowlders of volcanic origin, brought into their present position by running water. Volcanic breccia and volcanic conglomerates are likewise designated by the term "lava." The most common form of lava is the material of the "light-colored, fine-grained, homogeneous beds, resulting from the consolidation of the ashes and volcanic mud."

The lava of the tufaceous variety is sometimes very compact, and has a metallic ring when struck, resembling "clink-stone" (phonolite) in this respect. In this lava crystals of glassy feldspar often occur.

The lava is nearly always found "capping" (overlying) the gravel, but in some localities it occurs interstratified with the gravel.

Beautiful dentritic markings (called "photograph rocks") are often found covering the lava. These markings are usually mistaken for impressions of plants, but they are of inorganic origin, having been formed by percolating waters, carrying oxide of manganese and oxide of iron, which substances have assumed the dendritic or tree-like form.

Cement is a term of variable signification. In some districts it designates volcanic material of brecciated or conglomerated character. In other localities it refers to a quartz (non-volcanic rock) conglomerate cemented by oxide of iron.

Pipe-clay is more or less indurated clay, of non-volcanic origin, forming finely laminated beds. It generally occurs interstratified with beds of sand, etc.

Plants, infusorial earth, etc., imbedded in the clay and lava deposits, are often found; fragmental specimens of leaves of various kinds, carbonized wood, and a sort of lignite is found abundantly in the channels. There is an abundance in many localities of petrified wood, formed by the silicifying actions of percolating siliceous waters. The fossil flora of the gravel beds is different from that of the present time, and is referred to the miocene or to the pliocene epoch of the tertiary age.

Often intercalated in the deposits of white lava, are found beds of infusorial earth. This substance is the remains of the silicious shells of microscopic plants (diatoms).

This earth has a magnesian or chalky aspect, is very light, and does not effervesce or dissolve with acids. Diatomaceous deposits are common in the European tertiary.*

Gravel.—The term refers to the water-worn pebbles or bowlders which occur generally as a more or less compact conglomerate, immediately overlying the bedrock. There is considerable heterogeneity in the lithological character of the conglomerate, though pebbles or bowlders of a quartzose character often predominate. Usually subordinate to the quartzose pebbles or bowlders are others, which are sometimes foreign to the lithology of the district, and have been transported long distances.

---

* The lava, volcanic sediment, and pipe-clay but very rarely carry any gold, and the presence of the gold in these formations is entirely fortuitous.

In some channels, the gravel consists entirely of quartz, while in others, quartz is altogether absent.

The cementing or binding material is sometimes calcareous, but generally ferruginous and siliceous. The infiltrating waters carrying the siliceous and other cementing material have most probably come from above, and not, as Whitney suggests, from below. In most instances lava has been the material from which the transmitting agencies have been derived.

Color of Gravel.—The term "red gravel" is given to the brownish or reddish colored conglomerate which forms the top and overlies the blue gravel, which is the bluish, grayish, or greenish colored gravel nearest to the bedrock.

The gravels owe their color to the difference in degree of oxidation and hydration of the iron constituents which form the cementing or binding matter of the conglomerate. The "blue gravel" has very often iron in the form of finely divided iron pyrites, and to the presence of this mineral, and of some of the ferrous salts, most probably is due the peculiar color. The oxidation of the ferrous salts and the pyrites converts the iron into anhydrous sesquioxide, which imparts the red color to the red gravel. The addition of water changes the anhydrous to the hydrous sesquioxide, and the gravel assumes a hue more or less brown, depending upon the degree of hydration, and is seen as a variety of red gravel.

As has been shown, the color of the gravel is entirely independent of the source from which it has been derived.

Color of Gravel as Indication of Value.—That the blue gravel is rich gravel cannot be true other than in a relative sense. It is true that the blue gravel is almost always richer than the red gravel, but, *per se*, the color of the gravel is no criterion of its absolute value. The gravel is richer nearer the bedrock than in the upper portions of the deposits, because of its great specific gravity, etc., and the color of the gravel in the lower portions is blue, because the lower horizons are less exposed to the oxidizing influence than the upper horizons of the deposit, where the atmospheric agencies have had access and have changed the original blue color of the deposit to the red color now characteristic of top gravel. The gold occurs disseminated throughout the greater portions of the red and blue gravel. It is not uniformly distributed, but is finer as regards its texture, and less abundant in the top gravel than below in the blue gravel. The pay gravel is generally confined to the blue gravel, and in some mines, especially where the more expensive process of drifting is adopted, the "pay gravel" rarely extends more than three to five feet above the bedrock. Where a schistose rock forms the bedrock, the gold is often found included between the laminæ, several feet below the bedrock.

The quartz bowlders found in gravel mines often carry considerable gold. At Polar Star Mine, Dutch Flat, a white quartz bowlder was found which contained $5,760 worth of gold. The gold has undoubtedly been derived from the gold-bearing quartz veins so numerous along the western slope of the Sierras. By water it has been transported and deposited along with the detritus in preëxisting valleys, where now found. In the quartz veins the gold rarely exists of such large size as often found in the gravel deposits, and this would seem to be incompatible with the theory of its source as above given.

Formation of Nuggets.—To explain this seeming incongruity several theories have been advanced. Professor Whitney is of the opinion that the gold veins were richer nearer the surface in pliocene times than now, and maintains that gold veins get poorer as depth is attained. In the judgment of the writer, who has examined nearly all the mines of this State, there is no connection between the richness of the ore and the depth at which found. A more plausible explanation of the formation of the nuggets is, as has been suggested by Le Conte and other geologists, that their large size is often due to a chemical as well as a mechanical phenomenon. It seems probable that the gold has been re-dissolved and re-precipitated. By oxidation, the iron pyrites has been changed into the sulphate. Percolating solutions of the sulphate of iron dissolve the gold with which it comes in contact, and coming in contact later with organic or other reducing agencies, the sulphate of iron is changed by them to the sulphuret, depositing the gold as this change takes place. By the deposition of gold in some such manner, from solutions constantly in the same place, nuggets are formed.

WIDTH OF CHANNELS.

The width of channel worked in hydraulicking varies from one hundred and fifty to one thousand feet. The width of the deep rivers on top varies from a few hundred feet to several thousand. At Columbia Hill, Iowa Hill, and other places, the rivers are from one mile to a mile and a half wide.

In some places, where the gravel deposits have a great extent, laterally the width may be due to the confluence of two or more streams or tributaries.

Broad expanses of alluvions may also indicate the embouchures of the ancient rivers at these points.

The configuration of the western slope of the Sierra Nevada Mountains, of tertiary times, differs from that of to-day in one important respect: in tertiary times the slope was more uniform and more gently undulating at the valleys, through which flowed the pliocene rivers, which were broader and shallower than those of to-day.

As a consequence of this, we find broad pliocene rivers as contrasted with the more narrow and torrential streams of our times. As Whitney says: "The gravel rivers, when choked with debris, had room to make for themselves new channels to one side or the other. They refused to be confined within fixed limits, and thus wear down one narrow channel, because the volume of water was too great."

This shifting of courses has given the ancient rivers their present labyrinthine aspect, and has complicated the study of their systems. The rivers are generally broadest at their bends, owing to the shifting of their courses, as the banks on the concave side wear away.

The uniformity that is generally considered as a characteristic feature of the distribution of the gold in gravel channels rarely exists. On the other hand there is almost always a great fluctuation in the value of gravel taken across the stream and likewise along the course of the stream. The larger channels are usually less "spotted" as regards the value of the gravel than the smaller channels.

In drift mining this tendency is well marked in the occurrence of the "pay leads," to which the extraction of gravel is restricted. These leads are usually near the lowest depression of the channel, but often make to one or the other side and have most sinuous courses and varying widths. The width of these pay leads is determined primarily by the cost of mining. Where low grade gravel can be profitably worked, the width of the pay lead obviously would be greater than where a more costly system prevails.

Pay leads one hundred to one hundred and fifty feet are regarded as of about the average width. Where rich gravel, $5 to $8, is the minimum grade worked, such leads are often only from fifty to seventy-five feet wide.

Where gravel of $2 to $4 is being mined, the width of the pay lead may often reach three hundred to four hundred feet.

GRADE OF THE RIVERS.

As with the rivers of the present day, the grade of the pliocene rivers is very irregular, varying from five feet to two hundred and fifty feet or more per mile. (In some of the smaller tributary channels, the grade is four hundred feet and upwards per mile.) In common with the rivers of to-day, they have falls, rapids, etc., and exhibit all other characteristic fluviatile phenomena. The direction of flow of the pliocene rivers is indicated by differences in level between points on the bedrock, and also, where settling has not occurred, by the bedding of the deposit. The smaller ends of rocks, it is generally believed, point down stream.

As compared with their modern representatives, the pliocene rivers had less grade in their upper portions and more in their lower courses. The gradients of the pliocene rivers were also more uniform, but even in some of the larger channels the grade increases or decreases rapidly within a short distance. In the Bloomfield Channel, within a thousand feet, the grade decreased from one hundred and fifty feet (its average grade) to fifty feet per mile.

DEPTH OF GRAVEL.

The depth of the gravel deposit (*i. e.*, the height of the bank as it now exists) is exceedingly variable, not only as between the different mines, but in the same mine, owing to the erosion of the surface, which has given rise to superficial inequalities.

In some places, as at Table Mountain, Tuolumne County (see section of this deposit), the gravel is not more than two feet in thickness. In other places the gravel deposit attains, it is stated, a depth of six hundred feet, as at Columbia Hill, Nevada County.

DISTRIBUTION OF GOLD.

The paragenesis of the gold in the auriferous gravels of California differs from that in similar formations elsewhere, in the comparative paucity of the associated minerals.

Zircon, magnetic pyrites (chiefly in the form of sand), and garnets are the most abundant minerals accompanying the gold; but platinum, iridosmine, rutile, epidote, diamonds, chronite, topaz, cassiterite, and other minerals, also occur. The gold appears in size from minute particles (finest flour) to large nuggets* weighing several pounds. Gold from size of flax seed to melon seed is, as a general thing, considered coarse gold. Gold from top gravel is textually fine, and also of high grade, the coarser gold being nearer the bedrock. The gold usually is of a flattened character, well rounded on its edges. Occasionally the gold is rough and but little water-worn, and frequently still in its matrix. Gold found in upper gravel often has preserved its crystalline form. Rusty gold is often found in the alluvions. The rusty character of the gold is probably due to a coating of silica and sesquioxide of iron. It is not readily, indeed at times not at all amalgamable. Such gold, when saved, is recovered entirely by reason of its specific gravity. The richest gravel, as a rule, occurs on and near the bedrock. Sometimes, however, equally rich gravel is found in the upper horizons of the channels, notably on benches occurring on the inner side of a bend in the course of a channel. At Cherokee, Butte County, immediately overlying the bedrock, is a coarse, strongly cemented conglomerate, of a bluish color, carrying but little quartz. The depth of this conglomerate will vary from ten to fifty feet. On top of this conglomerate is a layer of soft blue gravel, varying from one to ten feet in thickness. This layer carries gold quite freely. Overlying this soft blue gravel lies a stratum *sui generis*, called "rotten bowlders," which consist of decomposed quartz, carrying gold varying from $2 to $5 a cubic yard. Above this stratum lies a stratum of quicksand of unknown thickness. At the present time, on top of this stratum of quicksand lies a stratum of hard, tenaceous pipe-clay over three hundred feet in thickness. On top of this pipe-clay is a deposit of basalt one hundred to five hundred feet in thickness. Owing to the large quantity of barren superincumbent material, hydraulic mining has been abandoned. The company purpose to introduce drift mining. The old washings of surface ground near Malakoff, Nevada County, from 1870 to 1874, is estimated at about three million two hundred and fifty thousand cubic yards, the yield of which was about $2\frac{9}{10}$ cents per cubic yard. The Bloomfield Company, from November 29, 1876, to October 13, 1877, washed one million five hundred and ninety-one thousand seven hundred and thirty cubic yards of top gravel, which yielded $3\frac{8}{10}$ cents per cubic yard. During the same period that company washed seven hundred and two thousand two hundred cubic yards of bottom gravel, which yielded $32\frac{9}{10}$ cents per cubic yard. The bottom gravel extended from bedrock to a height of sixty-five feet. All the gravel above that horizon was considered as top gravel.

The depth of the top gravel varied from a few feet to over two hundred feet.

The steep bedrock is more favorable for rich gravel than where the bedrock is flat, but often the gravel is poor where the channel is narrow and steep.

Gravel that yields remunerative results by the drift process has been worked in some instances from sixty to one hundred and fifty feet above bedrock. The coarser gravel ("heaviest wash") is the richest. The light "wash" and material of a sandy character, is usually poor in gold. The top gravel of hydraulic mines rarely pays for piping, unless worked in conjunction with the underlying richer auriferous deposits. The gold is often found in the grass roots of the vegetation covering the gravel deposits, but not in considerable quantities. The top gravel of a deposit is usually richer than that lying a foot or two below the surface, owing to the concentration of the gold superficially. In schistose rocks, as well as in decomposed granitic rocks, the gold is often found in the bedrock at a depth of from one to five feet below the surface. In drift mining, the bedrock is stripped to recover this gold. In hydraulic mining, bedrock of this character, when not too hard, is piped. When necessary, bedrock is blasted before being piped.

BEDROCK.

Bedrock is the rock which formed the bed over which the ancient river flowed. Slate is the common bedrock, though granite forms the bedrock in some localities. In different parts of its course the bedrock of a channel may change in character. The slate varies greatly in its lithological character. Chloritic, talcose, serpentine, and siliceous slates predominate. Schistose rocks are regarded as more favorable bedrock than granitic.

---

* The largest mass of gold found in California, within the knowledge of the writer, was extracted from the vein in the Morgan Mine, Calaveras County. It weighed one hundred and ninety-five pounds, and was worth $43,534. One or two nuggets worth from $25,000 to $30,000 each are said to have been found in gravel deposits of this State. There are many well authenticated finds of nuggets ranging from $5,000 to $10,000 in value. Large nuggets rarely occur in the large hydraulic mines.

Where the stream runs with the stratification of the bedrock, the gravel is usually richer than where it cuts across the stratification. In some deposits strata of indurated clay, or of compactly cemented gravel, form what is called a false bedrock. This bedrock often occupies an horizon considerably above the true bedrock. Sometimes the conditions of drainage necessitate the adoption of this stratum as the working bedrock of the mine, and operations are conducted with reference to this false bedrock, in lieu of the true bedrock.

YIELD OF CHANNELS.

The aggregate length of the ancient channels has been estimated at four hundred miles. This does not include the so called cement channels, which are but of subordinate economic importance. The yield, per mile, of channels of the average character is, at a low estimate, from $2,000,000 to $3,000,000. Good channels for drifting yield from $100 to $500 per lineal foot of the stratum extracted. From one fifth to one half of the gold in the channels usually may be obtained from drifting where the bedrock gravel is accessible; the lowest stratum of gravel, four to eight feet in depth, carries this portion of the aggregate gold contents in the channel.

SECTIONS OF GRAVEL DEPOSITS.

Section across Table Mountain (Tuolumne County), after Whitney.

1. Top. Basalt, overlying andesitic cement, sixty feet (forming a bluff sixty feet high).
2. Bluish soft sandstone, seventy feet.
3. Whitish clays, ten feet.
4. Auriferous gravels, two feet.
5. Bedrock slate.

Section through Shaft 1, Malakoff (North Bloomfield Gravel Mining Company).

Depth of eight to ten feet, soil.
To depth one hundred feet, gravel.
At one hundred feet, streaks of clay mixed with the gravel for a few feet.
At one hundred and twenty feet, a foot or two of sand.
At one hundred and thirty feet, much quartz; pipe-clay disappeared.
At one hundred and forty feet, gravel became more firmly cemented.
At one hundred and seventy-five feet, all the gravel well cemented.
At one hundred and ninety-five feet, thin strata of sand for a few feet.
Then to two hundred and five feet, more cemented conglomerate.

Section at La Grange Mine (Stanislaus County).

1. Top. Red soil colored by Fe_2O_3.
2. Coarse red gravel (containing granite pebbles, etc.).
3. Red cement (hard pan) gravel cemented by Fe_2O_3.
4. White siliceous clay.
5. Red cement (as No. 3).
6. Sand with pebbles.
7. Loose yellow sand.
8. Dark-colored gravel, containing debris of granite, slate, diorite, serpentine, etc., with some quartz.

It will be observed that quartz forms but a small part of the gravel at La Grange, which is indeed composed almost entirely of granite, diorite, etc. This is quite anomalous in the geology of the auriferous gravels.

The above sections will show how great a diversity exists in the relative depth or thickness of the material filling the channels. In some localities, the gravels are capped (overlaid) by two hundred to one thousand feet of "lava," "pipe-clay," sand, etc. In other places, as at Bloomfield, etc., where hydraulic mining was most successfully conducted, the volcanic formation is entirely subordinate, and comparatively little of the non-paying superincumbent material has to be "piped off" before the pay gravel is reached. The "lava" capping in Placer and Nevada County is not the "lava" flow which caps the gravel formations at places in Tuolumne, Butte, and other counties, but it is of a sedimentary origin.

In some channels, where the grade is very steep, there was no deposit of gravel. A subsequent deposition of volcanic sediment covered the bedrock. This occurrence is to be seen in the Black Cañon Channel.

SKETCH 1.

CROSS SECTION OF SECRET HILL AND CANADA HILL CHANNELS.

This sketch shows the *elevated* position of this ancient river system, with respect to the modern drainage system (North Fork of American River), and the sea level. Some gravel deposits of this class occupy altitudes even higher than the Canada Hill system. This deposit has been drifted at several points, and also hydraulicked where the volcanic capping had been denuded.

E. represents an isolated bench of gravel about one half mile long and eight hundred feet wide. The grade of this channel is very steep, being about six feet per one hundred feet. Channel is about three hundred feet wide at gravel line.

SKETCH 2.

CROSS SECTION OF RIDGE BETWEEN NORTH AND MIDDLE FORKS OF THE AMERICAN RIVER.

This sketch shows where the deep river system is *below* the drainage level of the district. The diversion of the ancient stream into other channels was caused by the volcanic flow. The submerged position of the deep river channels with respect to the present river systems is not usual in the upper portions of their courses. Near Oroville, the Feather River passes over a submerged ancient channel.

SKETCH 3.

LONGITUDINAL SECTION OF DAMASCUS CHANNEL AND CROSS SECTION OF THE RED POINT CHANNEL.

This sketch shows the older (Damascus) channel, which has been cut through by the younger (Red Point) channel. The gravels filling these channels have been derived respectively from different sources. The gravel of the Damascus Channel is white, and is almost entirely composed of quartz pebbles and bowlders, while that of the Red Point Channel is black, and consists of a slate, very siliceous and highly metamorphosed.

SKETCH 4.

CROSS SECTION OF DAMASCUS AND BOB LEWIS CHANNELS.

Dotted lines, M. N. and M'. N'. show the original channel. These rims have been washed away since the "volcanic" deposit was found. F. F. F. are benches of gravel left on the west rim of the ancient channel. There were, probably, corresponding benches on the east rim, which, together with the rim, have been washed off and obliterated. Subsequent to the deposition of the gravel in the Damascus Channel system (C. and F. F. F.) a new channel (E.) has crossed and scoured out the older channel (C.). The gravel of the Damascus Channel is white, while that of the Bob Lewis Channel is black. The dotted lines M. N. and M'. N'. represent the original Damascus Channel's rims. The east rim of the original channel has been entirely carried away by the younger (Bob Lewis) channel.

SKETCH 5.

CROSS SECTION OF RED POINT CHANNEL AT HOG'S BACK AND BLACK CAÑON.

The Black Cañon Channel has a grade of eight feet to the one hundred in places. The space included within the dotted lines N. M. Y. M'. N'. has been obviously denuded since the deposition of the volcanic cappings. M. represents the vertical depth of the erosion subsequent to the volcanic formation. The vertical depth at this point is from one thousand eight hundred to two thousand feet. The dotted lines N. M. R. and N'. M'. R'. are the rims of the ancient channel. These rims were eroded subsequent to the deposition of the volcanic cappings. The harder capping has resisted erosion, while the softer slate rims have been denuded. Dotted line M. M. represents level of channel at time of lava flow.

SKETCH 6.

CROSS SECTION OF RED POINT AND DAMM CHANNELS.

E. is mixed quartzose (white) gravel on rim. This was left by some ancient channel which was subsequently scoured out by Red Point Channel (black gravel channel). Dotted line N. M. denotes the probable original west rim of the ancient channel, and N'. M'. the probable east rim. There have been, probably, three channels of different ages in this locality. The quartz channel, of which E. is a remnant, has been scoured out and obliterated by the younger black slate channel (Red Point Channel). The east rim, N'. M'., of the valley, through which the ancient Red Point River flowed, has been partly eroded by the youngest river of the three systems; *i. e.*, the Damm Channel.

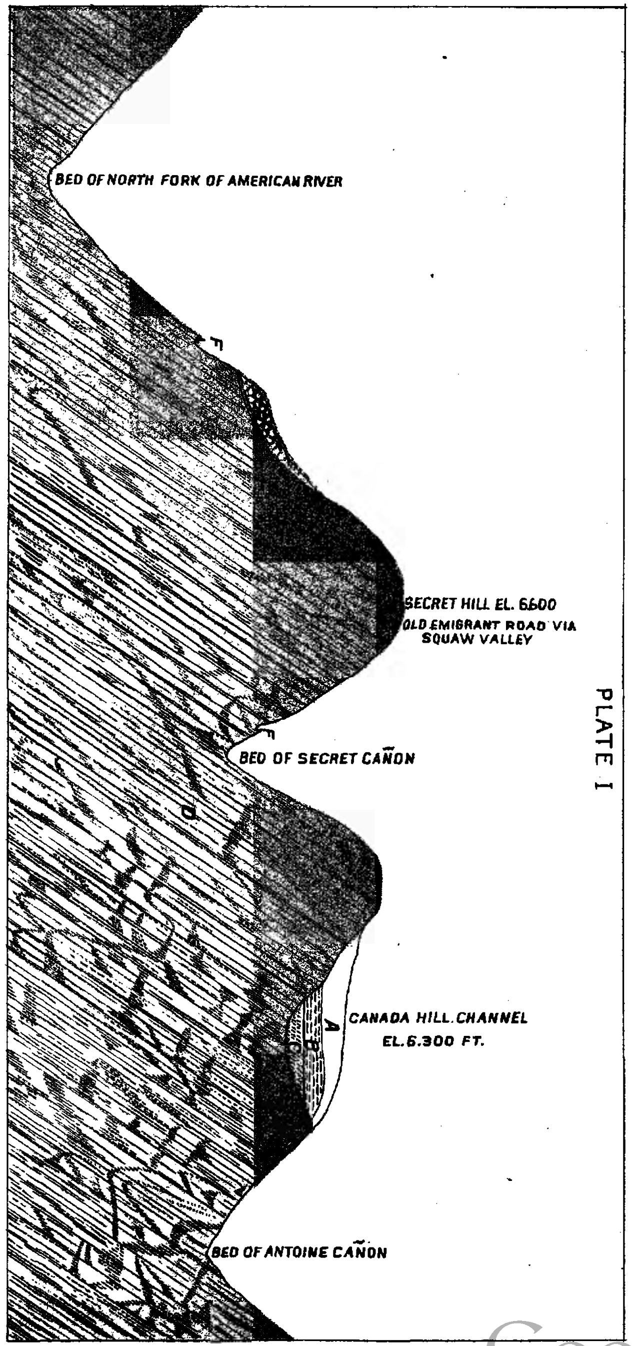
SKETCHES 7 AND 8.

LONGITUDINAL AND CROSS SECTIONS OF IOWA HILL CHANNEL SYSTEM.

The gravel channel, as illustrated in this sketch, has been entirely carried off in places through erosion by the North Fork of the American River, and by the waters of the Indian Cañon. The volcanic capping (volcanic sediment consolidated), which originally covered the channel, has been denuded at Iowa Hill and at Wisconsin Hill. At those points the gravel has been profitably hydraulicked, while the gravel which underlies the Morning Star Hill is not susceptible of being hydraulicked on account of the superincumbent volcanic capping. Where this capping was not more than fifty feet deep hydraulicking paid. The lower stratum of blue cemented gravel has been extensively drifted. The width of this channel shown in plate 8 (cross section) is nearly two miles.

NOTE.—These sketches are not made to scale.

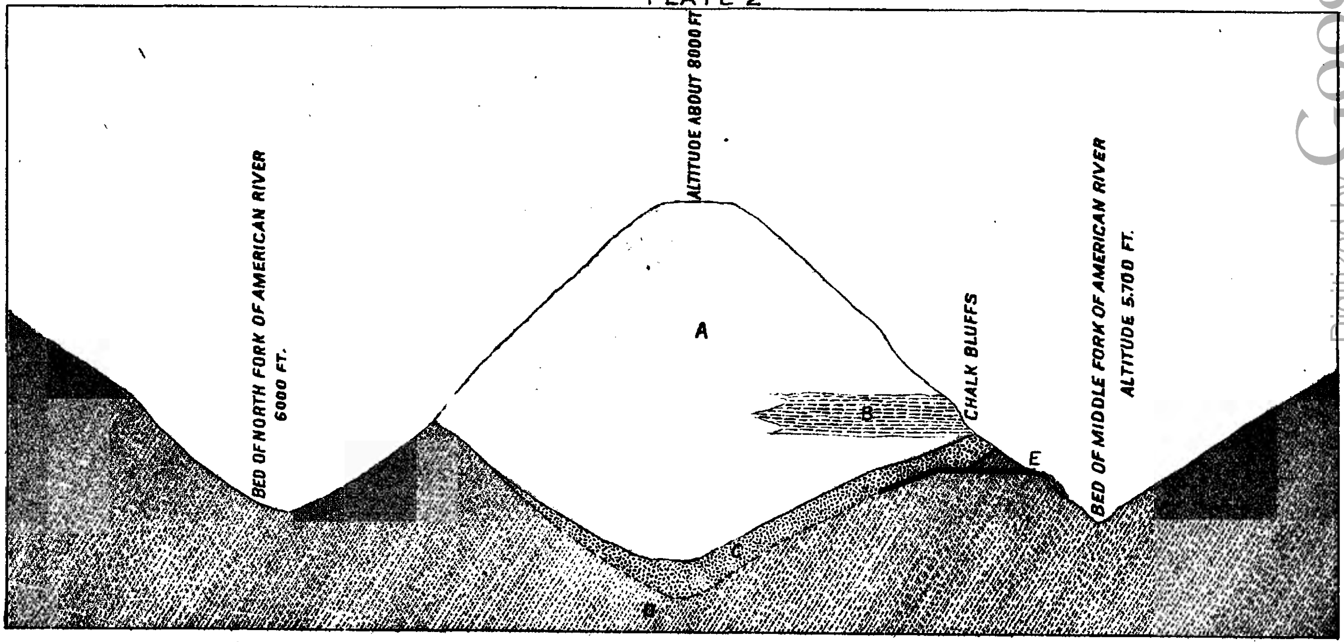
PLATE I


BED OF NORTH FORK OF AMERICAN RIVER
F
SECRET HILL EL. 6600
OLD EMIGRANT ROAD VIA SQUAW VALLEY
E
BED OF SECRET CAÑON
D
CANADA HILL. CHANNEL EL. 6.300 FT.
A
B
C
BED OF ANTOINE CAÑON

CROSS-SECTION OF SECRET HILL AND CANADA HILL CHANNEL. SKETCH (AFTER HOBSON).

A. Volcanic Cement Capping, 40' to 150' deep.
B. Cemented White Siliceous Sediment, 40' deep.
C. Angular Gravel, quartzose, said to contain from $1 to $5 per ton.
D. Slate Bed-rock, gashed with numerous veins of quartz.
E. Bench of Gravel.
F. Iowa Hill Canal.

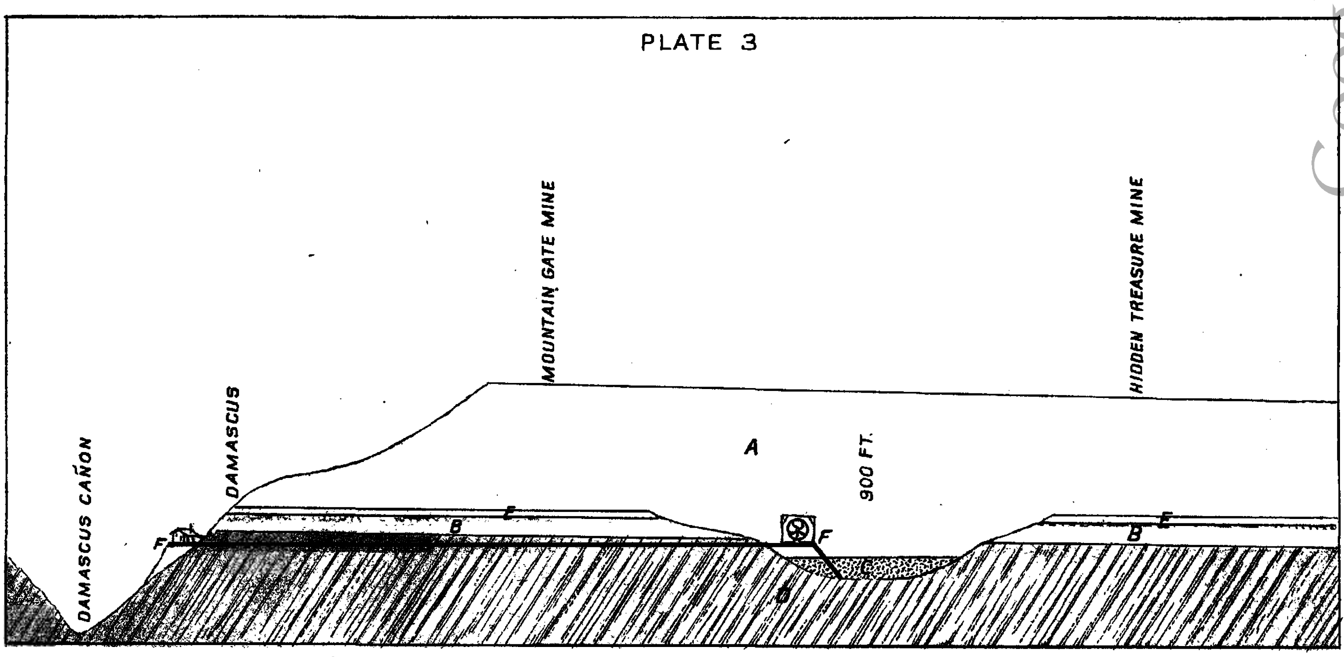
PLATE 2


ALTITUDE ABOUT 8000 FT
BED OF NORTH FORK OF AMERICAN RIVER
6000 FT.
A
B
CHALK BLUFFS
E
BED OF MIDDLE FORK OF AMERICAN RIVER
ALTITUDE 5.700 FT.
C
D

CROSS-SECTION OF RIDGE BETWEEN NORTH AND MIDDLE FORKS OF AMERICAN RIVER.

A. Volcanic Capping.
B. Cemented White Siliceous Sediment.
C. Gold-bearing Gravel.
D. Granite Bed-rock.
E. Prospect Tunnel and Slope **(inclined shaft) sunk on the rim to work the gravel deposit.**

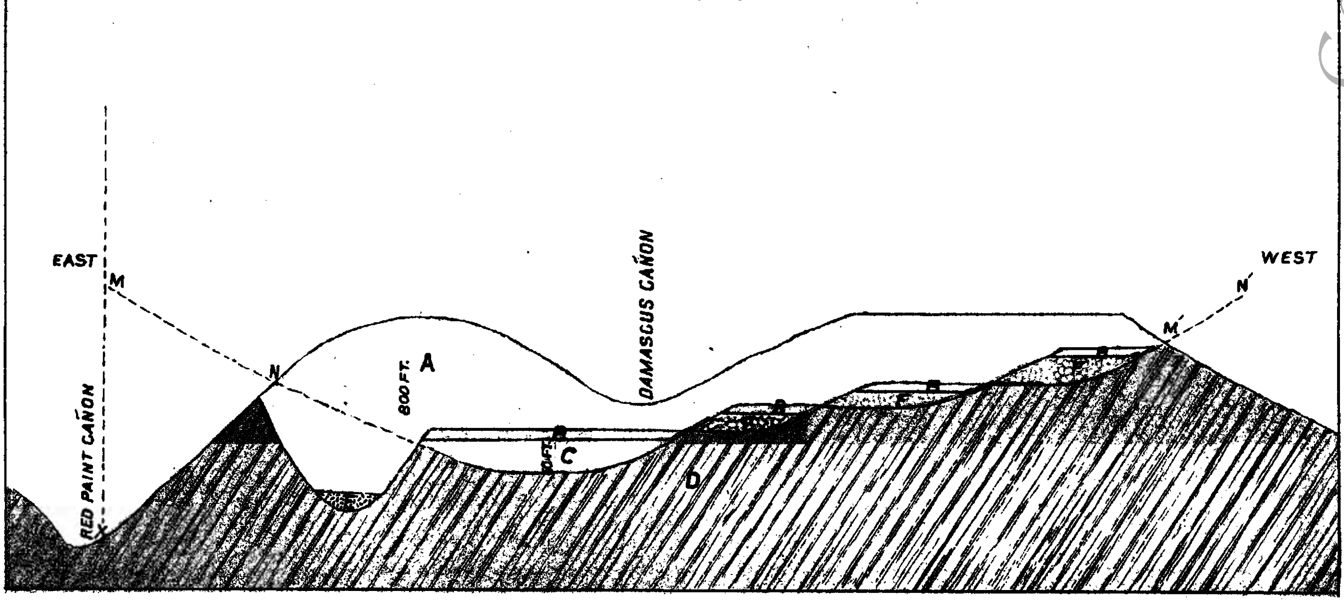
PLATE 3



LONGITUDINAL SECTION OF DAMASCUS CHANNEL, AND CROSS-SECTION OF RED POINT CHANNEL.

A. Volcanic Capping.
B. Damascus Channel (Gravel composed almost entirely of white quartz.)
C. Red Point Channel (Gravel composed almost entirely of black, highly siliceous slate.)
D. Slate Bed-rock.
E. Pipe-Clay.
F. Working Tunnel and Incline.

PLATE 4



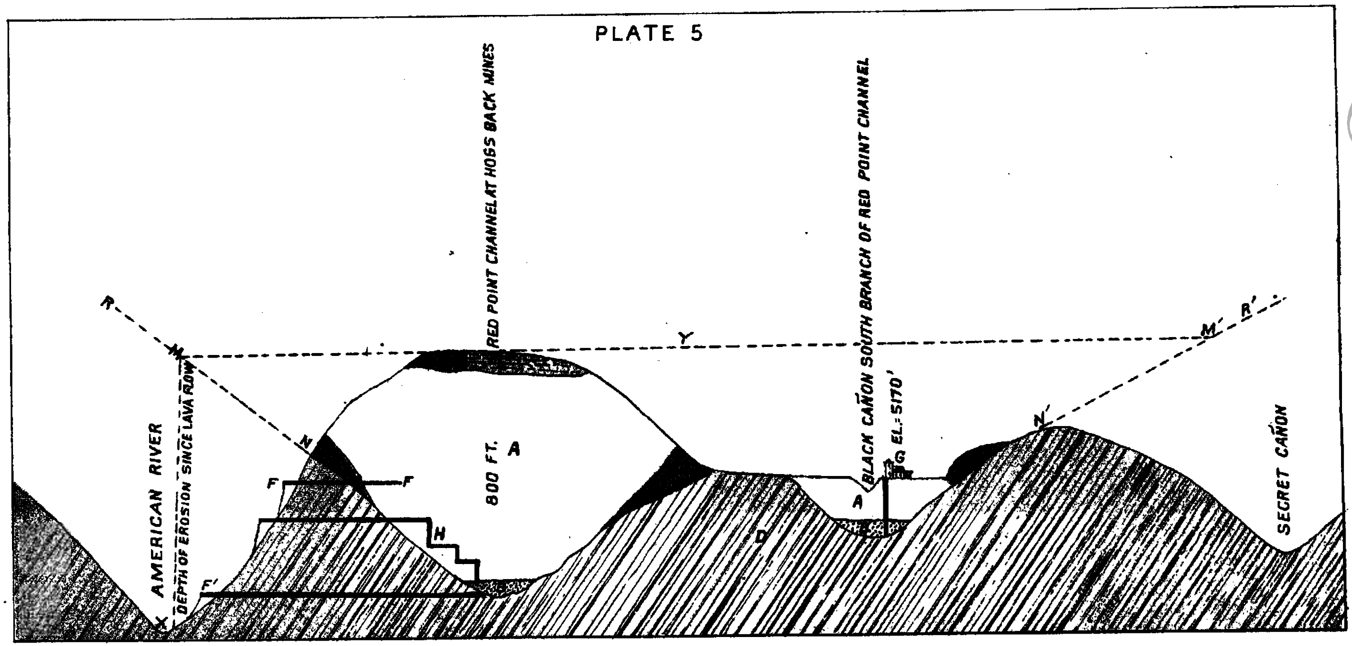
CROSS-SECTION OF DAMASCUS AND BOB LEWIS CHANNELS.

A. Volcanic Capping.
B. Pipe-Clay.
C. Damascus Channel, white quartz gravel.
D. Slate Bed-rock.
E. Bob Lewis Channel, dark gravel.
F. Rim benches of quartz gravel.

E is 150′ wide.

C is 1000′ wide, and has been worked to width of 300′.

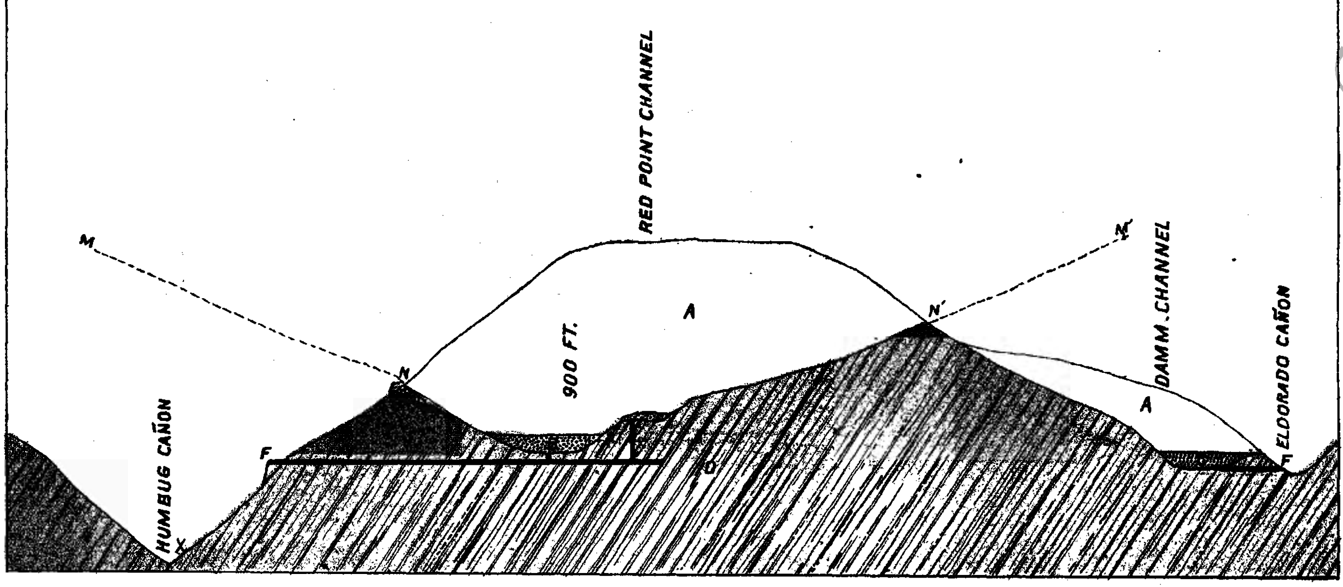
PLATE 5


RED POINT CHANNEL AT HOGS BACK MINES
BLACK CAÑON SOUTH BRANCH OF RED POINT CHANNEL
EL.=5170'
AMERICAN RIVER
DEPTH OF EROSION SINCE LAVA FLOW
SECRET CAÑON
800 FT.
R
M
N
X
F
F'
H
A
D
G
Y
N'
M'
R'

CROSS-SECTION OF RED POINT, HOGS BACK AND BLACK CANON CHANNELS.

A. Volcanic Capping.
B. Gold-bearing Gravel Channels.
C. Mixed Gravel on Rims.
D. Slate Bed-rock.
E. Deposit of angular Debris and Boulders.
F. Prospect Tunnels.
F'. Tunnel being run to bottom gravel deposit.
G. Black Canon Shaft and Hoisting Works.
H. Prospect Winzes to strike Gravel.

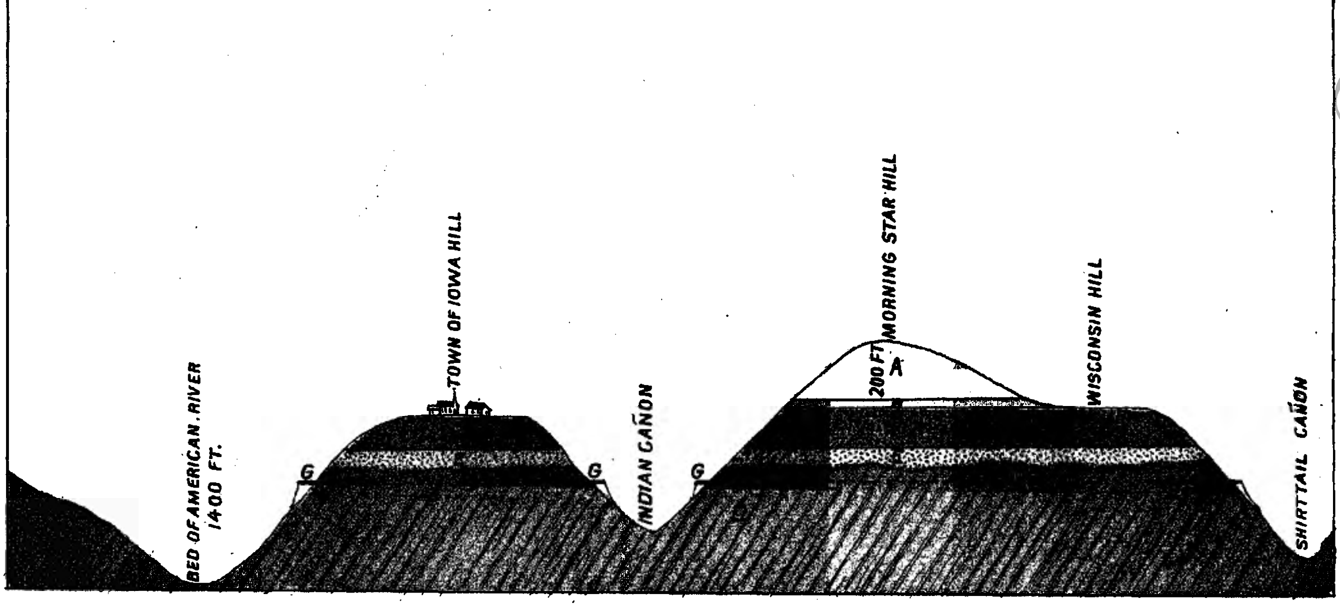
PLATE 6



CROSS-SECTION OF RED POINT AND DAMM CHANNELS.

A. Volcanic Capping.
B. Red Point Channel.
C. Damm Channel.
D. Slate Bed-rock.
E. White Quartz Gravel on Rim.
F. Working Tunnels.

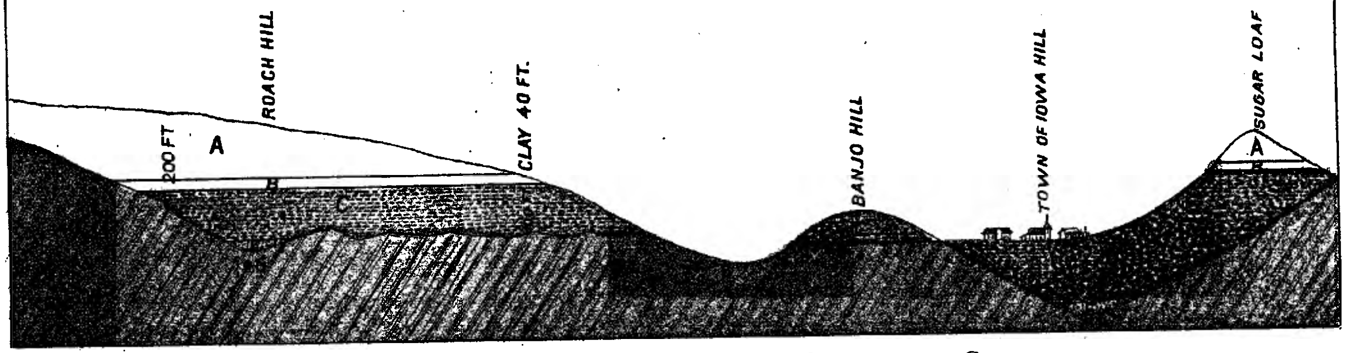
PLATE 7



LONGITUDINAL SECTION OF IOWA HILL CHANNEL SYSTEM.

A. Volcanic Capping.
B. Pipe Clay.
C. Mixed Quartz Gravel, generally fine.
D. Slate Bed-rock.
E. Blue Gravel of Iowa Hill main Channel.
G. G. Tunnels.

PLATE 8



CROSS-SECTION OF IOWA HILL CHANNEL SYSTEM.

A. Volcanic Capping.
B. Pipe Clay.
C. Mixed Quartz Gravel.
D. Underlying Slate Rock.
E. Blue Channel, Wolverine Channel.
F. Main Blue Gravel, Iowa Hill Channel.
G. G. Tunnels.

METHODS OF MINING.

The mining of the deep placers may be divided into two classes, viz.: drift mining and hydraulic mining. As is well known, the hydraulic mining has been almost entirely restricted during the past six years by adverse legal decisions. This stoppage of hydraulic mining has given a great stimulus to drift mining, many of the enjoined hydraulic mines being now worked by drifting. But there are many gravel deposits that are peculiarly adapted to profitable hydraulic mining that are not susceptible of remunerative drift mining. In some mines the gold is more or less uniformly distributed throughout the gravel, and the lowest stratum is not rich enough to pay for the drifting, while hydraulicking can be profitably conducted.

The lithological character of the material filling the old river channels will determine which of the systems is to be pursued. Where a great depth of lava (as in the case of the Table Mountain formation, a section of which has been given) or other non-paying material is superimposed upon the auriferous pay gravel, drift mining must be resorted to. The exploitation of such large quantities of barren material would not be practicable, and by the system of drift mining this is obviated. In some places there is a concentration of the gold in a stratum immediately overlying the bedrock, while the rest of the deposit carries an amount of gold too small to admit of profitably hydraulicking the entire deposit. When such is the case, recourse is had to drift mining. Again, lack of grade, lack of dump, or the absence of other conditions requisite for hydraulic mining, make it necessary to adopt drift mining instead of the hydraulic system.

In drift mining, the deposit is worked through a shaft or through a bedrock tunnel. The latter system is preferable and is adopted where the topography of the district admits, inasmuch as the necessity of draining the mine by pumping and of elevating the gravel is obviated. Fortunately, the topographical features are often favorable to the working of the deposits by tunnels. To reach the gravel deposits, a bedrock tunnel is run from some neighboring cañon through the rim-rock to a point beneath the gravel at which exploitation is to begin. [*]In drift mining, where worked through tunnels, it is vitally important to determine the approximate elevation of the gravel deposits, so as to run the tunnels sufficiently below the gravel to admit of working the deposit by gravitation. When the tunnel is run above the bedrock (except in cases where a false bedrock is adopted as working level), the deposit cannot be worked without elevating the water and gravel.

This is a costly and rarely practicable system of mining. Many disastrous mining failures have attended the faulty location of a bedrock tunnel. The bedrock tunnels are sometimes more than a mile in length. These tunnels cost from $5 to $40 per running foot, $12 to $16 being about the average, depending upon their dimensions, and chiefly upon the hardness of the ground. Power drills are generally used in running long tunnels. While in rock of medium hardness there is no economy in the use of these drills; in effecting a saving of time they are valuable. On the other hand, where the rock is exceptionally hard, the use of air drills effects the saving both of money and time. The dimensions of the tunnels, where run by hand, are generally about five feet wide and six and one half feet high. Where run by air drills, they are often as wide as eight to ten feet, and from seven to eight feet in height. Sometimes, to make speed, two drills are worked at the same face, in which case the width of the tunnel is from eight to ten feet. From one hundred and fifty to four hundred feet of tunnel may be run monthly by using air drills. The tunnel, where run in bedrock, but rarely requires much lagging and timbering. When run in gravel, this is an expensive item of cost. From the tunnel, upraises are made into the gravel deposit. These upraises are one hundred and fifty to two hundred feet apart, and serve as chutes. From the top of the upraises, gangways are run through the gravel, and the deposit is blocked out by cross drifts, and exploited in a manner similar to the working of horizontal seams of coal. The gravel is usually worked to a height of five to eight feet. Where the bedrock is soft, and of a laminated character, it is taken out to a depth of from one half foot to four feet, and washed with the gravel. The large bowlders are picked out and stowed back in the excavated ground. The gravel is wheeled, or brought by small cars, to the gravel chutes, leading to the bedrock tunnels. Through these chutes it is dumped into the cars in the main tunnel. These cars, where the tunnel is long, are drawn (six to ten constituting the train) by animals, or by locomotives,* and emptied automatically upon "dumping chairs" near the mouth of the tunnel. The cars carry from one to two tons of gravel. The best grade for the tunnel is three to four inches per hundred feet.

---

[*] Within a few years, the projection of the ancient channel upon maps to distances of several miles beyond the nearest visible point has been correctly made by engineers, who have made a specialty of this class of engineering work. In this connection the delineation of the Red Point Channel (see sketches 3, 5, 6) and the determination of the best site for a tunnel to open up the gravel deposit, is deserving of note. This successful and very creditable work was done by Messrs. Ross E. Browne, John B. Hobson, and Charles Hoffman. (See article by Russell L. Dunn, in Report of State Mineralogist 1888.)

The gauge of the track is from sixteen to twenty-two inches. T rails, weighing from twelve to thirty pounds, are generally used, but in some mines wooden rails, covered with strap iron one to two inches in width by one quarter to one half inch thick, are used. T rails are unquestionably preferable. Track of this character can be laid at from 50 to 60 cents per foot. In the gangways through the gravel, the track is a temporary structure that can be conveniently moved from the abandoned gangways.

Outside of the tunnel the track divides into three branches. One track leads to the waste dump, where the waste rock from the bedrock tunnel, etc., is dumped. Another track leads to a small "prospect" bin, into which the gravel to be tested as to its richness is discharged. The third (main) track leads to the main gravel dump.

EXTRACTION OF THE GOLD.

The gold is extracted either by:

First—Sluicing, when the gravel is "free," *i. e.*, not cemented.

Second—By the milling process, when the gravel is cemented.

The process of sluicing is essentially similar to the washing of the gravel in hydraulic mining. The cars are run on to dumping chairs, which dump the gravel automatically. The gravel falls into a wooden bin, heavily boarded, and sometimes covered with light sheet iron. At the bottom of the bin is the head of the line of sluices, into which the gravel is directed by the slope given to the sides of the bin. This structure is generally covered over to protect the men from the inclemency of the weather. The water is introduced by a pipe connected with the water tank, and the gravel is washed into and through the sluices. Where the water supply permits, the gravel is washed once a day. A permanent and sufficient water supply is very desirable for washing the gravel, but at many mines there is a scarcity of water, in consequence of which the gravel can only be washed at irregular intervals.* Sometimes the gravel is stored in bins for several months, awaiting available water; at some places the drain water from the mine is stored in a large water tank near the head of the sluices, and when a sufficient quantity has accumulated, is used for washing the gravel. Occasionally, water from this source is sufficient for this purpose, but usually the supply has to be supplemented by water from elsewhere. It requires from one sixth to one twelfth of an inch of water to wash a cubic yard of "free" gravel. The sluices are wooden boxes from eighteen to twenty-four inches in width and depth, and usually twelve feet in length. They are set on a grade of eight to eighteen inches per twelve feet, and paved usually with iron riffles that may be readily removed. The length of the string of sluices is rarely more than a few hundred feet—most of the gold is caught within one hundred feet of the head of the bin when the gravel is very free. Drops and undercurrents should be more frequently used in this connection than is the practice, and more quicksilver added to the sluices. At many mines, where the gravel is somewhat cemented, the tailings are impounded below the sluice and allowed to slack, after which they are rewashed by a second string of boxes below the dam.

The milling process is adopted when the conglomerate is too strongly cemented to be disintegrated (as in the sluicing process) by means of water. The gravel must then be crushed in a gravel mill, which, in most respects, is similar to the mills employed in the reduction of gold ores. The gravel is crushed through coarse screens, three sixteenths of an inch mesh in diameter, and is mostly caught in the battery by amalgamation. Outside copper plates, as in gold milling, are also used. The capacity of gravel mills is from five to twelve tons per stamp in twenty-four hours. It takes from one third to one fourth of an inch of water to mill a cubic yard.

Mills for gravel should have double discharge mortars. They should have rock breakers and self feeders. No attempt is made to save the sulphurets, which are usually found in the conglomerate. These sulphurets (and magnetic sands) are auriferous, but generally not rich or abundant enough to pay for saving. The cost of mining by this method is, of course, exceedingly variable.

COSTS OF DRIFT MINING.

Where the deposit is worked by tunnels and the gravel is free (not cemented), under favorable conditions gravel may be mined and washed for 90 cents to $1 25 per cubic yard; where the gravel is cemented and requires much blasting the cost of mining will be considerably increased. Such gravel also has to be milled, further enhancing the cost from 20 cents to 40 cents per ton. Under favorable conditions of mining and milling, cemented gravel may be worked at a cost of from $1 75 to $3 50 per cubic yard.

The mines are ventilated in the most improved systems by blowers (Baker's, etc.) run by machinery. This is a cheaper and far more effective system than ventilation by means of air shafts and air drifts kept open for that purpose. The latter system costs from $3 to $5 per lineal foot of channel worked, while the former costs less than 50 cents.

---

* At Bald Mountain the gravel was brought from the mine a distance of over seven thousand feet, by a locomotive, drawing a train of eighteen cars, carrying two tons per car. The locomotive weighed seven and one half tons. The trip was made in five minutes. Anthracite coal was used for fuel. According to Superintendent Wallis, the relative costs of transportation at Bald Mountain were: By man power, 21 cents per carload (two tons); by mule, 9 cents per carload; by locomotive, 4¾ cents per carload.

*The dumps where the gravel was stored awaiting water for washing, at the Bald Mountain Mine, had a capacity of twenty-six thousand and sixteen thousand carloads, respectively.

EXAMPLES OF DRIFT MINES.

May Flower.—Situated in Placer County. From December 11, 1888, to September 24, 1889, the company's twenty-stamp mill crushed thirty-three thousand seven hundred and eighty-seven tons of cemented gravel, which yielded $272,616 50, or 8\frac{6}{100}$ per ton. But few mines have as rich gravel as this. The monthly expenses of the company ranged from $10,000 to $13,000. A lineal distance on the channel of one thousand six hundred and twenty feet yielded the thirty-three thousand seven hundred and eighty-seven tons referred to.

Hidden Treasure.—Situated on the Damascus Channel (see sketches), Placer County. The gravel worked is not cemented, but is cheaply mined and is "free milling;" *i. e.*, it does not require crushing. This ground is "picking" ground, requiring no blasting. The timbering expense is, however, much greater than that of the cemented gravel mines. From February 27, 1888, to June 30, 1888—one hundred and eight working days—the figures are:

	Per Load—One Ton.	Total.
Gold yield	$1.2347	$39,821 53
Wages	$0.7202	$23,528 00
Contracts	.1077	3,464 78
Expense, material, etc	.0957	3,086 94
Total expense	$0.9236	$30,079 72
Profit	.3111	9,741 81

Number of days' labor, 11,164.50. Number carloads gravel, 32,252.

For the eleven years, 1877 to 1887, inclusive:

Receipts.	
Gold yield	$879,523 27
Receipts from other sources	19,176 16
Total	$898,699 43
Expenditures.	
Wages	$490,297 64
All other expenses	137,064 35
Dividends	268,092 00

The cost per carload ($0.9236) is exceptionally low, as under ordinarily favorable conditions $1 50 to $1 75 a carload is as low a figure as can be anticipated, and in most of the mines the cost is from $2 to $3.

The yield of this mine last year was, approximately, gross: $81,000; expenses, $51,000; net, $30,000. The value of the gravel per ton was $1 56. One hundred and twenty men were employed.

Bald Mountain Mine.—Situated in Forest City, Sierra County. The owners of this property invested $20,000 in opening up the mine, with the following gratifying results:

YEAR COMMENCES JULY FIRST—	Carloads.	Gross Yield.	Dividends.
1872–1873	50,168	$544,000 00	$284,000 00
1873–1874	65,782		
1874–1875	79,990		
1875–1876	100,080	296,341 76	150,000 00
1876–1877	98,044	235,803 57	70,000 00
1877–1878	106,160	269,755 00	120,000 00
1878–1879	90,274	164,909 00	40,000 00
1879–1880	86,378	188,892 40	60,000 00
1879–Oregon Creek	----------	3,000 00	----------
	676,876	$1,702,701 73	$724,000 00
July, 1880		16,914 38	20,000 00
July, 1880, 920 feet, Oregon Creek		9,000 00	----------
August 1, 1880		$1,728,616 11	$744,000 00
From June, 1881, to June, 1887 (mine closed down, having been worked out)		803,124 00	240,000 00
Totals		$2,531,740 11	$984,000 00

In addition to this, upwards of fifty thousand was taken from the reworked tailings which had been run into the cañon to slack (disintegrate the cemented gravel). From 1881 until 1887 (when operations were discontinued) the gravel output was from sixty thousand to one hundred and seven thousand carloads (one and one fourth tons per car) annually. The costs of mining, washing the gravel, and general expenses, etc., were from $1 22 to $1 44 per carload of extracted gravel. During 1881–82 the gravel yielded 50⅓ cents per square foot of ground removed. The Ruby Gravel Mine, on the same channel as the Bald Mountain, has a pay lead of from fifty to three hundred feet in width (including the benches of gravel). Under the economical management of Mr. Pichoir, gravel is extracted from the breasts twelve thousand feet from the mouth of the tunnel, and washed at a total cost of only $1 25 per carload of one and one fourth tons. This gravel is free, and requires no blasting.

The record for this channel to the year 1880 is as following—three thousand eight hundred and fifty feet worked:

Gross yield	$1,788,000;	$465 per lineal foot of channel.
Working expenses	923,000;	$240 per lineal foot of channel.
Profit (including plaut)	$865,000;	$225 per lineal foot of channel.

This company owned seven thousand five hundred feet of channel.* The claim was worked out about three years ago. In full operation the mine employed from one hundred and twenty-five to one hundred and seventy-five men.

HYDRAULIC MINING.

The recent suppression of hydraulic mining by judicial decisions, has reduced the annual gold product of California by at least $10,000,000; has thrown thousands of men out of profitable employment, and has withdrawn enormous sums of money from circulation in the various channels of trade. Nor have the hardships which resulted from this been confined to persons directly connected with mining enterprises; being felt generally throughout the community, and they have fallen to a great extent on the very persons whom the decisions in question were designed to protect. Fortunately, however, the interdependence of the various industries of the State in this respect is becoming generally recognized, and thoughtful men, of whatever profession, are awakening to the desirability of rehabilitating the hydraulic mining of the State. It is greatly to be hoped that some method will shortly be devised for the accomplishment of this end, and for the effective prosecution of hydraulic mining, *in a manner which will at the same time insure to the farming interests of the State the protection to which they are entitled, and preserve the navigable rivers of the State as well.*

---

*Lava flow carried away five hundred feet of this channel.

In general, hydraulic mining consists in the disintegration of the auriferous alluvia, by propelling a heavy jet of water under pressure upon the bank, and in washing off the gravel in sluices in which is distributed mercury. The gold forms an amalgam and remains caught. The determining conditions of the profitable prosecution of hydraulic mining are:

First—Attainment of a large supply of water under a high pressure at not too great a cost.

Second—Facilities of obtaining the grade requisites for the sluices, and the dump for the refuse or "tailings."

MEASUREMENT OF WATER.

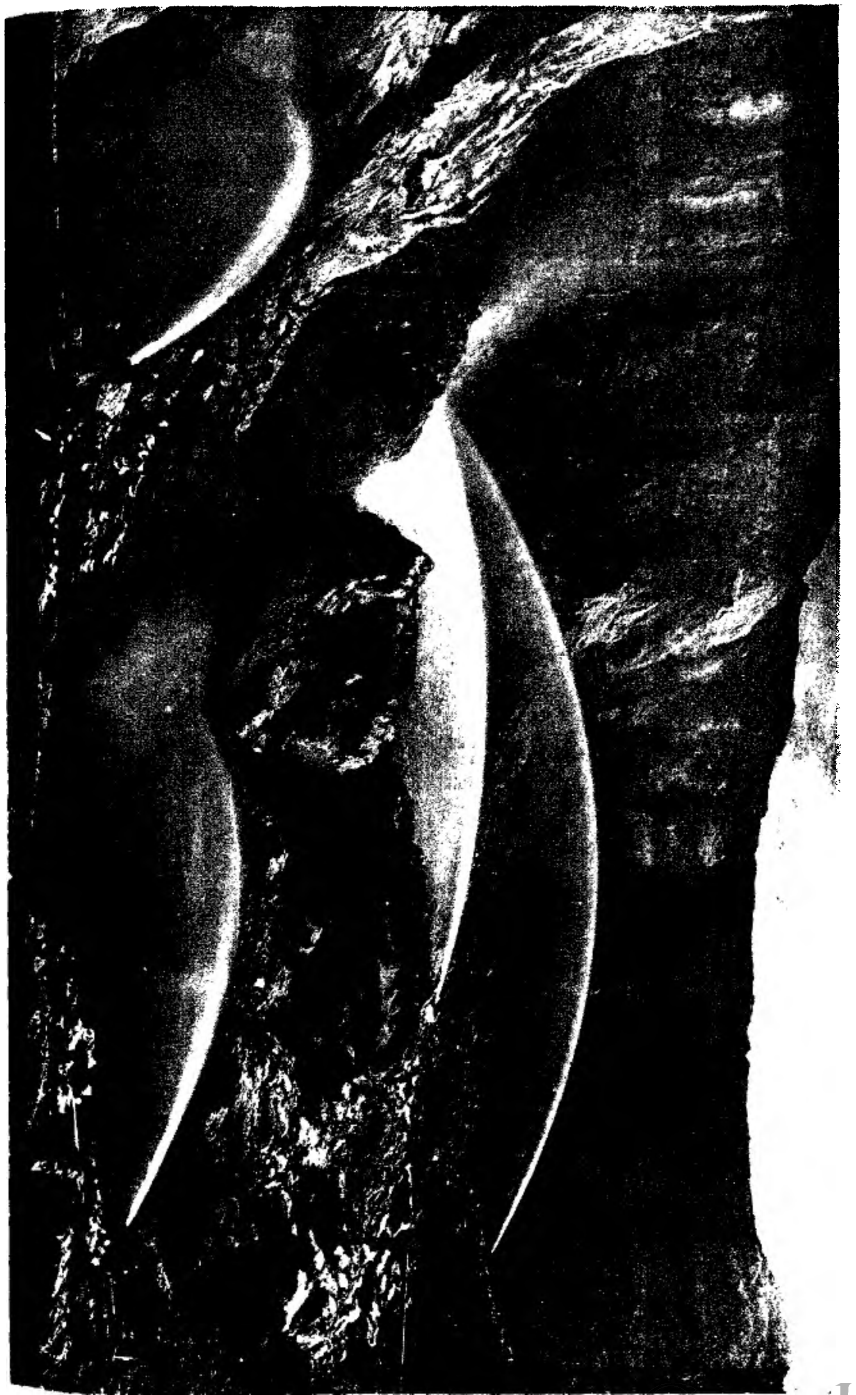
The method by which water is measured in the mining counties of California is that in vogue in Italy and Spain.

An aperture, whose sectional area represents a certain number of square inches, is cut through an upright or vertical board, which forms a portion of a confined box. The amount of water discharged through this orifice, divided by the number of square inches of the sectional area of the orifice, is called the "miner's inch."

The quantity of water represented by the "miner's inch" varies throughout the State by reason of the difference in pressure (*i. e.*, the height of the surface of water above the orifice), the thickness of the board through which the orifice is cut, etc., and ranges from two thousand to two thousand six hundred cubic feet per twenty-four hours of flow. The quantity of water discharging through an orifice one inch square, through a two-inch board, constitutes the "miner's inch" most generally adopted throughout the State. The quantity of water discharged under the above conditions for ten hours is called the ten hours miner's inch. The twenty-four hours miner's inch is that understood when not otherwise expressed. The miner's inch, as above described, is approximately sixteen thousand eight hundred gallons.

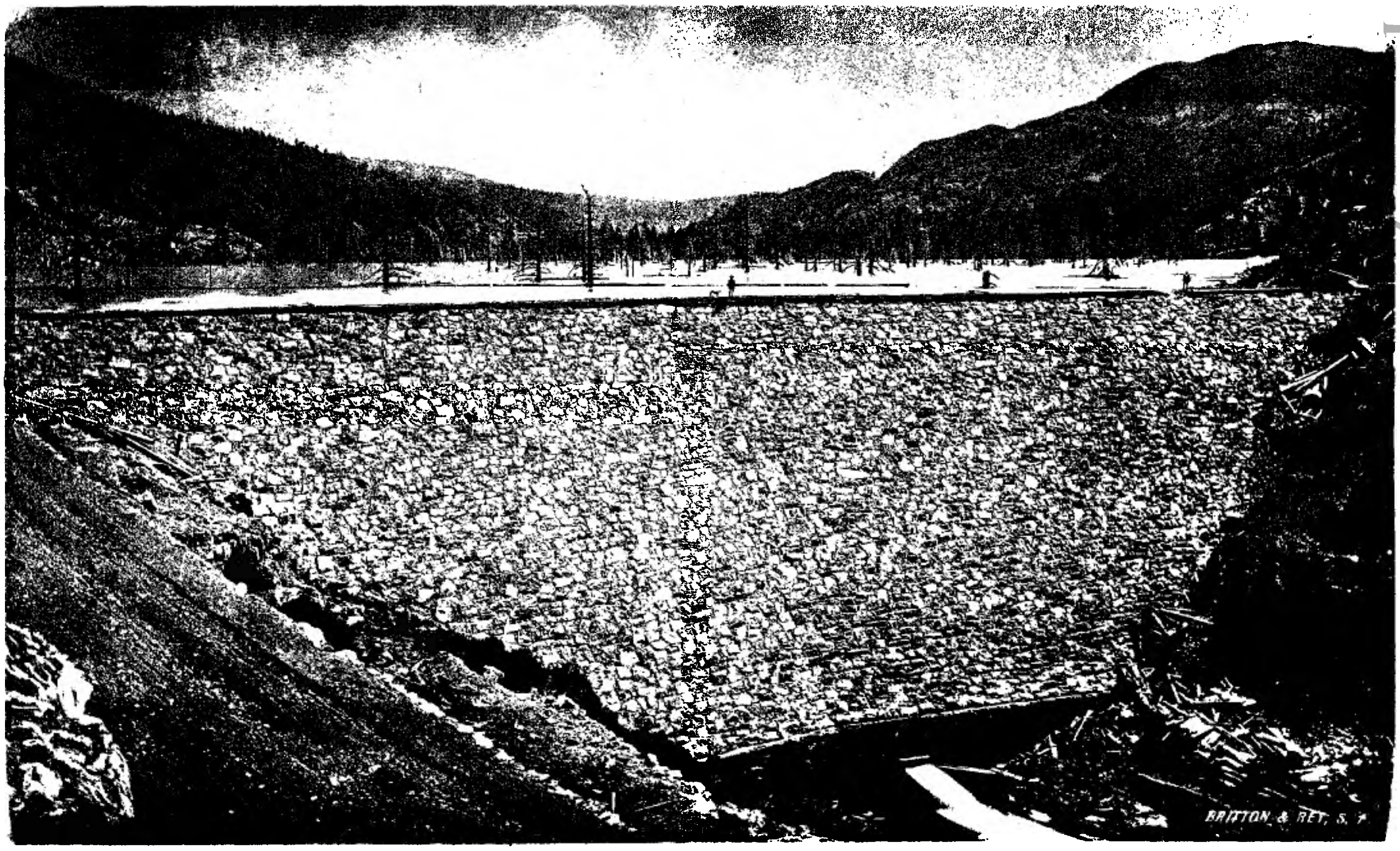
WATER SUPPLY.

The water used in hydraulicking is derived from the streams fed chiefly by the rains and melting snows. Where operations are conducted upon a comparatively small scale (the companies having no storage reservoir of any considerable capacity), the hydraulicking season is about coextensive with the rainy season, rarely being prolonged more than a month or two after the cessation of the rains. Under such conditions five to six months is about the duration of hydraulicking.



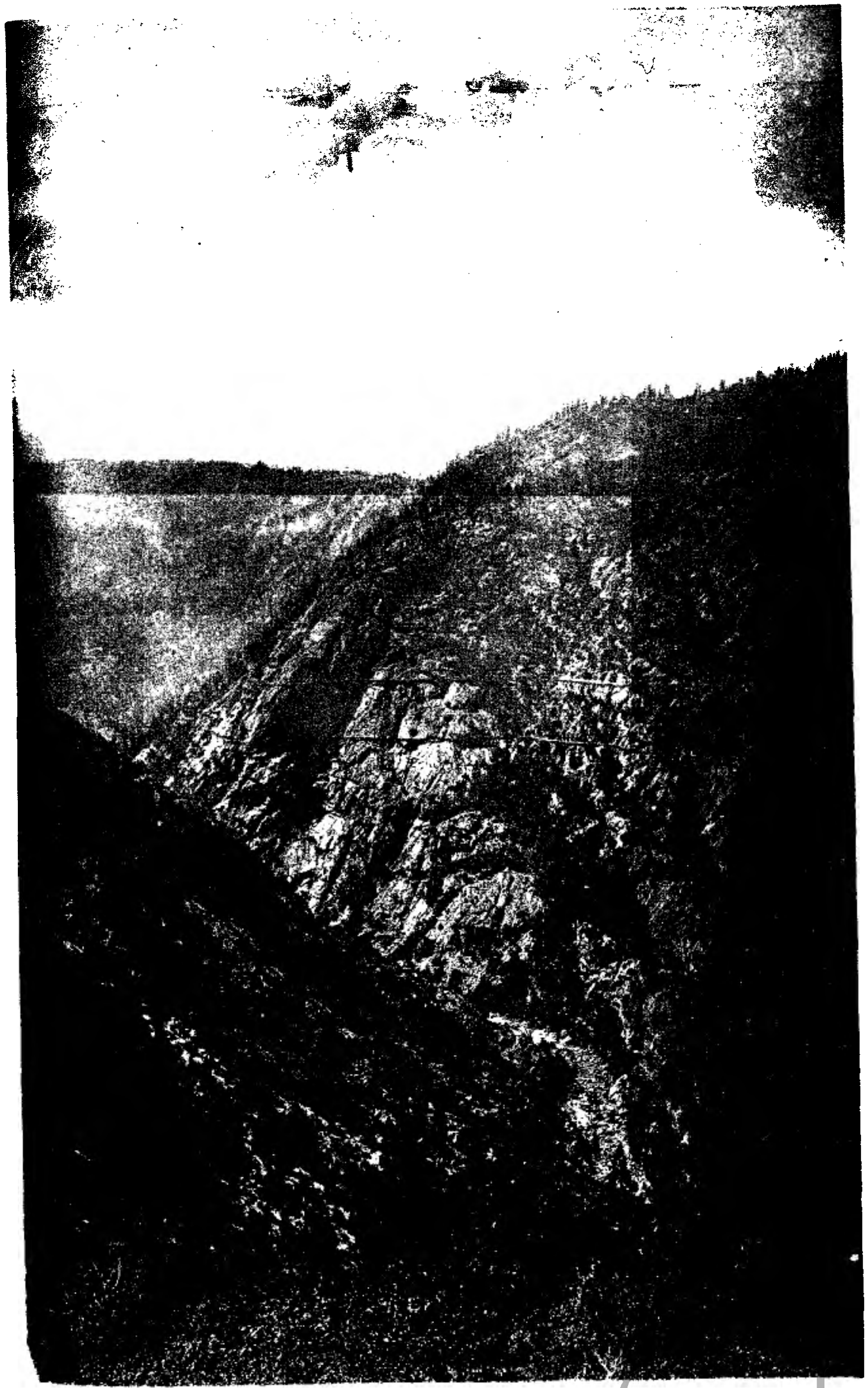
NORTH BLOOMFIELD MINE, NEVADA COUNTY.

NOTE.—In some localities in California, Idaho, Montana, and Colorado, "booming" is practiced. This system is adopted where there is a scarcity of water, or where the gravel is too limited in extent, or too poor in grade, to justify the expense of bringing in a permanent supply of water for hydraulicking. It consists in accumulating a supply of water in a reservoir at the head of the gulch where the gravel is to be washed, and discharging (usually automatically) the entire volume of water at once, so that the rush of the water carries off the gravel into sluices disposed for that purpose. Some of the gold is caught in the sluices—a great part obviously is carried off. Booming is confined to the gulch gravel.



BOWMAN (MAIN) DAM, NORTH BLOOMFIELD COMPANY.

Above sea level, 5,500 feet; height above bed of cañon, 98 feet; length on top, 420 feet; thickness at bottom, 167 feet; contains 55,000 cubic yards of stone; [illegible] sufficient to supply San Francisco for ten years; water brought by



BLUE TENT SYSTEM.
Flumes and ditches carried around steep and rocky mountain side.

Companies hydraulicking more extensively have storage reservoirs commensurate with the magnitude of their operations. Such companies are enabled to continue their piping with but little interruption during the entire year. The reservoirs constructed for mining purposes (chiefly for hydraulic mining) on Yuba, Bear, Feather, and American Rivers have an aggregating storage capacity of about fifty billion gallons, which is about twice as much as the Spring Valley Water Company's system.

The source of water supply of the North Bloomfield Gravel Mining Company, the Milton Mining and Water Company, and the Eureka Lake and Yuba Cânal Company (consolidated), is about the headwaters of Big Cañon Creek and Middle Yuba River in Nevada and Sierra Counties. The catchment area embraced in those sections represents in the aggregate 68.6 square miles. There are eleven principal reservoirs varying in area from ten acres to four hundred and eighty-seven and one half acres (high water area) each, and having a capacity of from $2\frac{1}{2}$ to 796.7 million cubic feet. The total area of the reservoirs of these companies is over eleven thousand six hundred acres (at high water mark) with a total capacity of over two billion one hundred and ninety-five million cubic feet.

In order to obtain efficient head or pressure, it is often necessary to bring the water from great distances. To overcome the topographical obstacles, considerable engineering skill is sometimes required. In Butte County the bracket flume of the Miocene Ditch Company is something unique in hydraulics.

In order to obviate the construction of a trestle some one hundred and eighty feet high, the water is conveyed in a wooden flume (four feet wide and three feet deep) around a bluff three hundred and fifty feet in height. The flume was suspended upon brackets made of T rails, bent in the form of a reversed L (⅃) soldered into holes previously drilled into a solid vertical escarpment; men were swung down by ropes to drill these holes.

In another place in this line of ditch is a piece of trestlework one thousand and eighty-eight feet long and eighty feet high.

Herewith is given the statistics of the water companies in the central mining counties of the State. The water of these companies is used principally for mining purposes.

Water for hydraulicking costs 5 to 25 cents an inch, when purchased from water companies; 10 to 15 cents is the usual price paid by hydraulic mining companies.

In 1877–78 the Bloomfield Company used eight hundred and fifty-five thousand miner's inches (twenty-four hours inches) of water, at a cost of $2\frac{6}{10}$ cents per inch.

La Grange Ditch and Hydraulic Mining Company, Stanislaus County. Water from Tuolumne River, eighteen miles from mine. Length of ditches, twenty-five miles. Dimensions: top, nine feet; bottom, six feet wide; depth, four feet; capacity, two thousand seven hundred miner's inches per twenty-four hours; grade of ditches, seven to eight feet per mile. Cost of ditches, etc., \$450,000.

Tuolumne County Water Company, Tuolumne County. Water from south fork of Stanislaus and tributaries. Miles of ditches, one hundred and twenty-five (fifty miles not in use now); six miles of flumes. Grade, ditches, eleven to thirty-two feet per mile. Dimensions of ditches: width, bottom, seven and a half to eleven feet; top, eleven to fifteen feet; depth, four feet. Ditches cost, on average, \$4 50 per yard; flumes, \$14 per yard; and pipes, \$6 per yard.

Union Water Company, Calaveras County. Water from north fork of Stanislaus River. Forty miles of ditches; capacity, two thousand five hundred miner's inches; water grade, three to twenty-five feet per mile. Total cost of plant, $200,000.

Mokelumne Hill and Campo Seco Ditch Company. Water from headwaters of Mokelumne River. Ditches, over one hundred miles; grade, eight to sixteen feet per mile; capacity of ditch, one thousand five hundred inches. Cost, about $500,000.

El Dorado Water and Deep Gravel Mining Company, El Dorado County. Main reservoir, Silver Lake, Amador County. Main ditch, forty miles; tributary ditches, seventy miles; total ditches, one hundred and ten miles; one mile of flumes; three miles of pipes. Dimensions of ditches: top, ten feet; bottom, six feet; depth, four feet; grade of ditches, four feet to mile; flumes, grade, one and one third to two and one half feet per mile; water delivered, four thousand inches. Reservoirs cost $45,000. Total cost of plant, $600,000.

California Water and Mining Company. Water from Loon Lake and Pilot Creek, in El Dorado County; two hundred and fifty miles of ditches; grade, six to sixteen feet per mile. Dimensions: top, three and one half to eight feet wide; bottom, two to five feet wide; one and one half to three feet deep; water supplied by ditches, one thousand two hundred inches; flumes, two and one half miles. Total cost of plant, $600,000.

Park Canal and Mining Company. Water from different branches of Cosumnes River; ditches, two hundred and ninety miles; flumes, eight miles; pipe, one mile; grade of ditch, one half to sixteen feet per mile. Dimensions: top, eight feet wide; bottom, five feet wide; two and one half feet deep; capacity of ditches, two thousand two hundred inches. Reservoirs cost about $60,000. Total cost of plant, $2,000,000. Ditches cost $10 per rod; flumes, $12 to $14 per rod; pipes, $2 50 to $4 50 per yard.

Iowa Hill Ditch Company, Placer County. Water from North Fork of American; twenty-five miles of ditches; capacity of ditch, three thousand inches. Plant cost $200,000.

North Bloomfield Company, Nevada County. Length (including reservoirs) of ditches, one hundred and fifty-seven miles; capacity, three thousand two hundred inches; grade, twelve to sixteen feet per mile. Dimensions of ditch: top, eight and two thirds feet wide; bottom, five feet wide; depth, three and one half feet. Cost of plant, $708,841. It costs $13,463 per year to keep the reservoirs and ditches in order.

Milton Company (including reservoirs). Length, eighty miles; grade per mile, twelve to twenty-five feet. Dimensions: top, six feet wide; bottom, four feet wide; depth, three and one half feet; capacity, three thousand inches. Cost, $391,579.

Auburn and Bear River Canal Company, Placer County. Seventy-five miles of ditches; capacity, three thousand inches. Cost, $350,000.

Amador Canal, Amador County. Ditches, sixty-six miles; capacity, two thousand inches. Cost, $400,000.

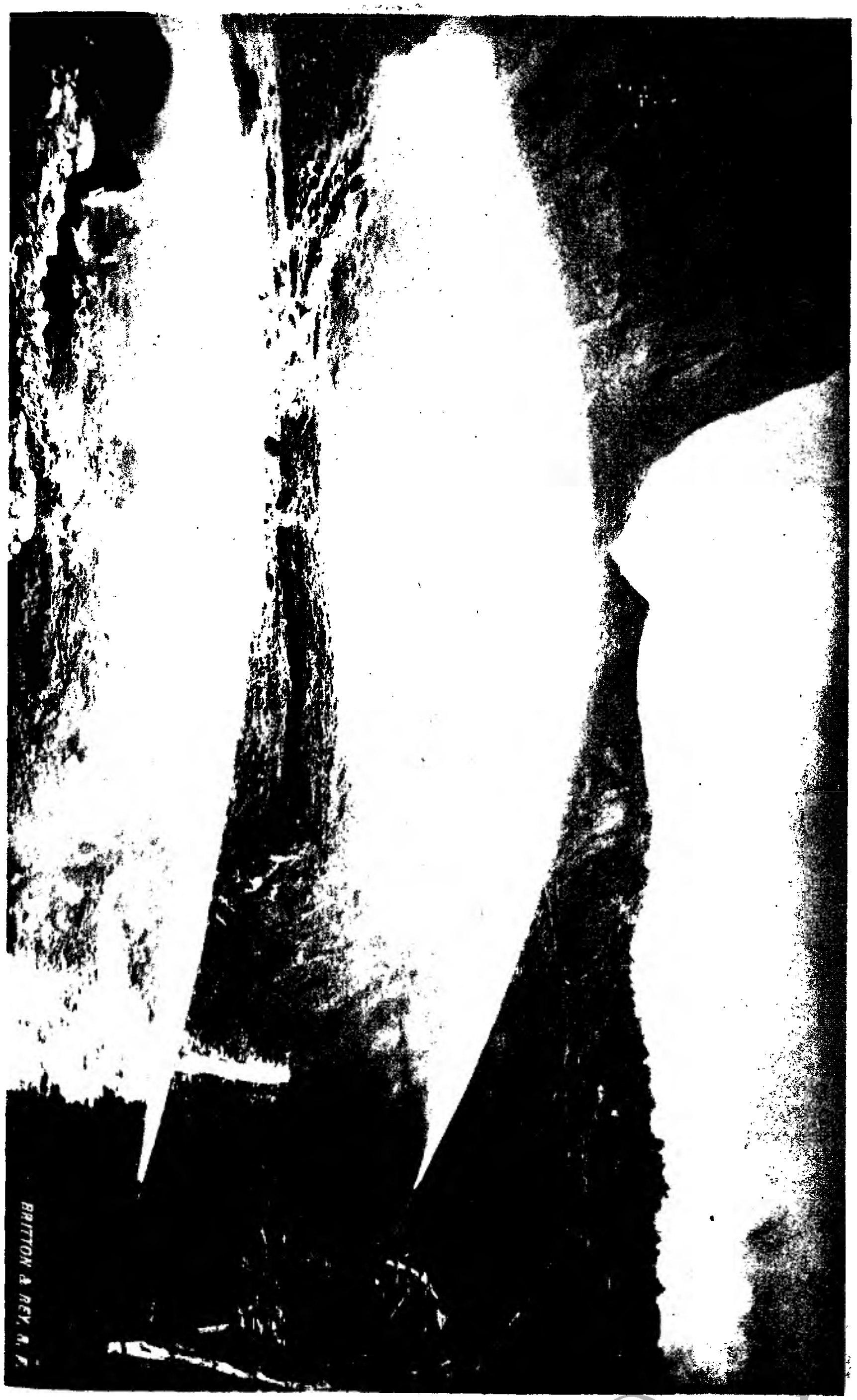
Brandy City. Ditches, seventeen miles; capacity, two thousand inches. Cost, $150,000.

Buckeye Company, Trinity County. Ditches, thirty-five miles; capacity, two thousand five hundred inches. Cost, $120,000.

Dardanelles Ditches, Placer County. Seventeen miles; capacity, three thousand inches. Cost, $125,000.

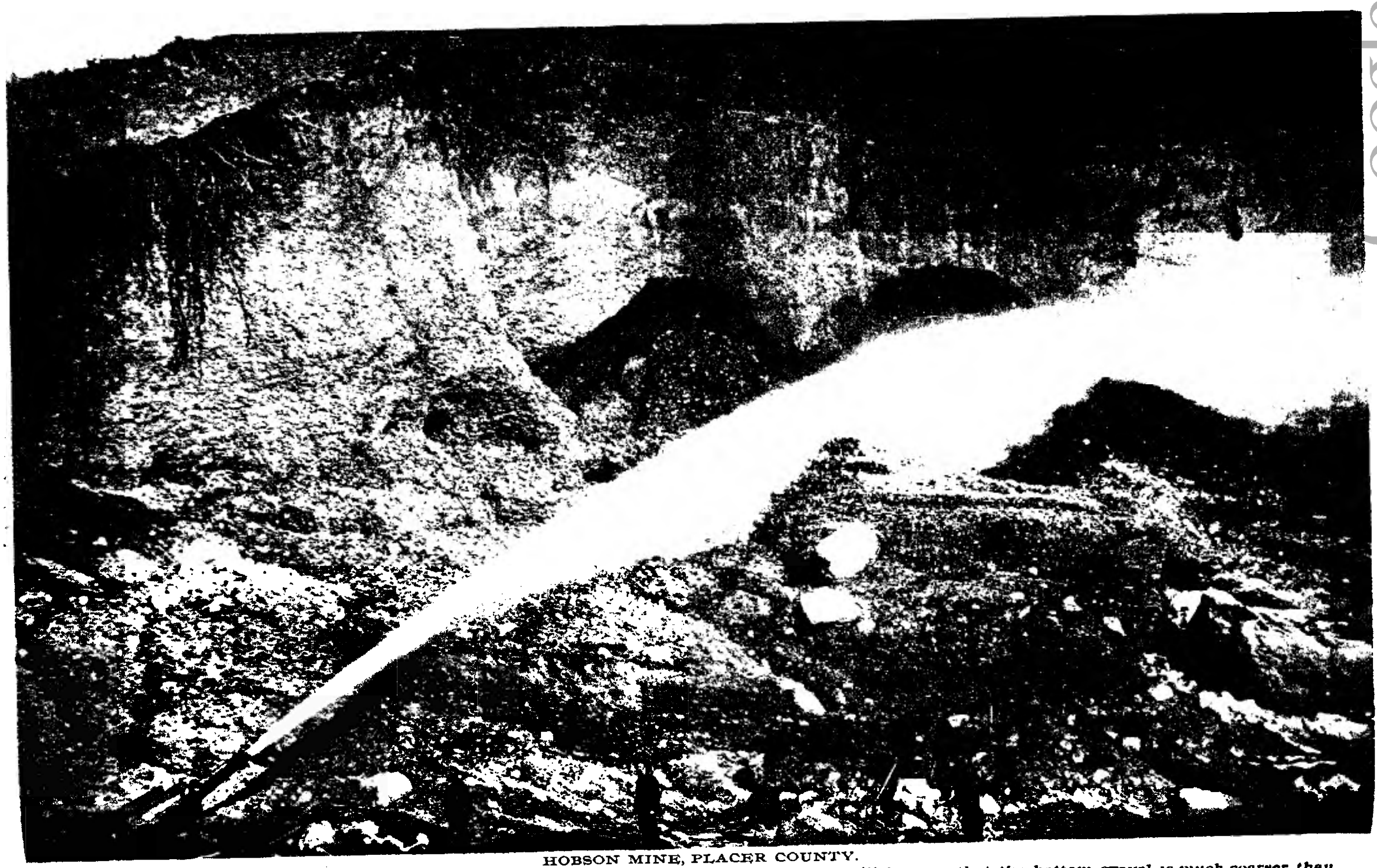
Del Norte Company. Ditches, ten miles; capacity, two thousand inches. Cost, $40,000.

Gold Run Ditch Mining Company. Ditches, twenty-six miles; capacity, two thousand five hundred inches. Cost, $150,000.



SPRING VALLEY MINE, BUTTE COUNTY.

Two streams piping. Gravel is washed into the deep bedrock cut which leads to the tunnel seen in background, right hand side of picture. This tunnel is three thousand feet long, and was driven to get outlet for tailings.



HOBSON MINE, PLACER COUNTY.

Monitor playing five hundred miner's inches under head of three hundred and sixty feet. It will be seen that the bottom gravel is much coarser than the gravel higher in the bank.

Little York and Liberty System, Nevada County, Cal. Ditches, thirty-five miles; capacity, three thousand five hundred inches. Cost, $150,000.

Natoma Water and Mining Company. Ditches, sixteen miles; capacity, three thousand five hundred inches. Cost, $390,000.

Phœnix Ditch Company. Ditches, one hundred miles; capacity, four thousand inches. Cost, $880,000.

Powers' Ditch, Butte County. Ditches, thirty miles; capacity, two thousand inches. Cost, $75,000.

California Water Company. One hundred and twenty-five miles; capacity, four thousand five hundred inches. Cost, $550,000.

Eureka Lake and Yuba Ditch Company. Length of ditches, one hundred and sixty-three miles; capacity, five thousand eight hundred inches. Cost $723,342.

South Yuba Ditch Company. One hundred and twenty-three miles of ditches; capacity, seven thousand inches. Total cost of plant, $1,100,000.

Smartsville Ditches. Capacity, five thousand inches; grade, nine feet per mile; cost, $1,000,000. Dimensions: top, eight feet wide; bottom, five feet wide; depth, four feet.

Spring Valley and Cherokee. Ditches, length, fifty-two miles; capacity, two thousand two hundred inches. Cost, about $500,000.

Hendricks. Ditches, length, forty-six and one half miles; grade, six to twelve feet per mile. Cost, $136,150.

Blue Tent. Ditches, thirty-one miles; capacity, two thousand one hundred inches. Cost, $200,000.

When feasible, ditches are used as conduits in preference to flumes or pipes, as the cost of construction and of maintenance is less than that of the flumes or pipes.

In some places, the topography of the country, the character of the ground (hardness, porosity, etc.), or other conditions, render the use of flumes more economical. Flumes are usually of smaller sectional area than the ditches, but are given more grade (twenty to forty feet per mile) to compensate for the reduced area. Flumes cost from $1 to $2 per linear foot.

At Cherokee, in Butte County, the water is conveyed across a deep ravine by an inverted siphon of wrought iron. The diameter of the pipe is thirty to thirty-four inches, and its greatest thickness, where subjected to a pressure of eight hundred and eighty-seven feet (three hundred and eighty-four pounds per square inch), was No. 00 iron, Birmingham gauge, 0.375 inches.

DUTY OF MINER'S INCH.

The duty of a miner's inch of water is the quantity of material which that amount of water is capable of moving. Obviously, the duty of a miner's inch will vary greatly, depending as it does on the quantity of water used, the pressure of the water, the character of the material washed, and the grade and width of the sluices.

NAME OF STREAM.	Quantity of Water Used in Mining and Discharged into Beds of Rivers in Twenty-four Hours—Inches.	State Engineer's Estimate of the Duty per Inch—Cubic Yards.	Amount Moved—Cubic Yards.
Table Mountain or Dry Creek	833,250	3½	2,916,375
Butte Creek	24,000	3	84,000
Feather River	1,259,363	3½	4,407,770
Yuba River	5,458,171	3½	19,103,598
Bear River	1,117,082	3	3,351,246
Dry Creek, No. 2	44,229	3	132,687
American River	1,914,500	4½	8,615,250
Totals	10,650,595	* 3.6	38,610,926

* Average.

These estimates are less than the actual results. Other conditions being the same, the duty of a miner's inch increases rapidly with an increased grade of the sluices. Le Conte says the transporting power of water is as the sixth power of its velocity.

At Hobson's mine, in Placer County, piping a bank one hundred and twenty feet high, of very light free gravel containing no cement, using five hundred inches of water, under a pressure of three hundred and sixty feet, with a twelve-inch grade (twelve inches to a box of twelve feet) for sluices, the duty of a miner's inch was twenty-four cubic yards. At the same mine, with the same grade, same quantity and pressure of water, but where the gravel was coarse and cemented, the duty was reduced to ten yards.

Under the same conditions of gravel bank and water supply as referred to in the first example given, but where the grade of the sluice was increased to eighteen inches a box, and where iron riffles were used instead of rocks, the duty of thirty-six cubic yards per inch was attained. These results are exceptionally high in hydraulicking. At Wisconsin Hill, Placer County, piping light top gravel with a grade of twelve inches per box of twelve feet, with five hundred inches stream, the duty of a miner's inch was ten cubic yards, while only three cubic yards of bottom and cemented gravel were washed under the same conditions.

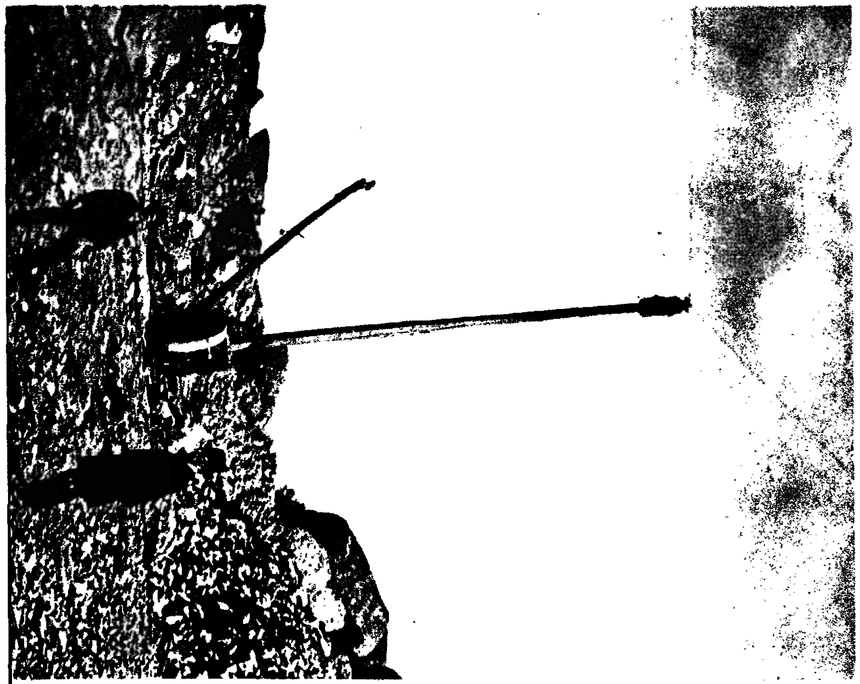
At the North Bloomfield, in washing one million five hundred thousand cubic yards of top gravel, the duty of a miner's inch was 5.39 cubic yards.* In washing seven hundred and ten thousand cubic yards of the underlying gravel (to height of sixty-five feet above the bedrock) the duty of an inch was but 2.34 cubic yards. In the latter case, thirty-five cubic feet of water were required to move one cubic foot of gravel.

DUMP, ETC.

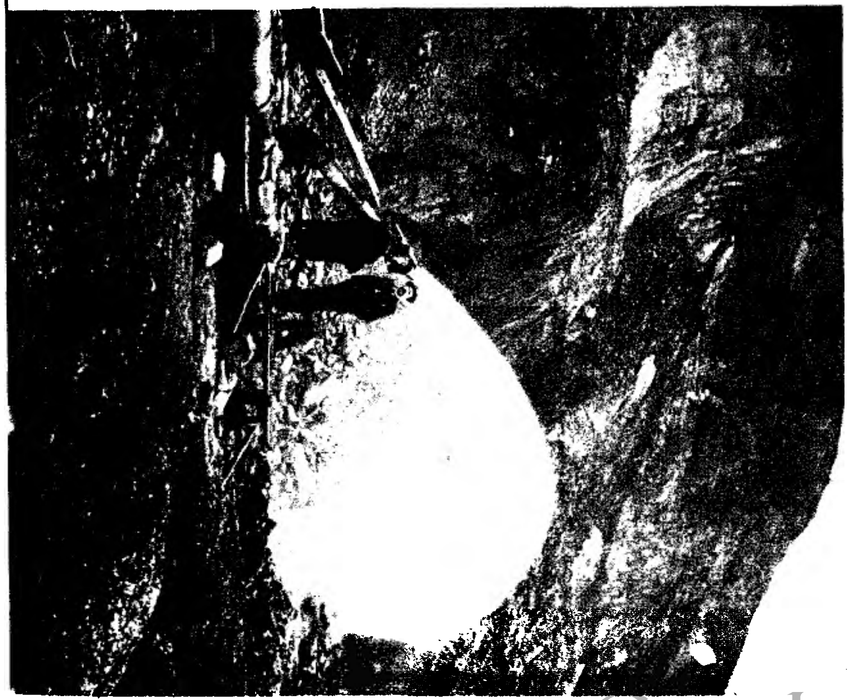
Less indispensable even than a good water supply is the available fall upon the property to secure sufficient grade for sluicing and satisfactory dumping ground for the tailings. Much room is required below the mine upon which to deposit the debris, where operations are conducted on a large scale. Where upwards of two millions of cubic yards of material

---

* At Bloomfield, twenty-four hours miner's inch equals two thousand two hundred and thirty cubic feet, the duty per miner's inch was ten cubic yards, while under the same conditions of pressure and grade of sluices, piping the underlying heavier cemented bottom gravel, the duty was but four cubic yards.



WATER POWER DERRICK FOR REMOVING HEAVY BOWLDERS.



MONITOR.

are moved annually, the mine, obviously, must have an extensive outlet for the debris. Deep cañons are the most favorable sites for this purpose.

In order to utilize the pressure due to the elevated position in which the water is brought, with respect to the gravel to be washed, the water is conducted from the ditches into a tank called the "pressure box" or "bulkhead." From the pressure box or bulkhead, by means of a feed-pipe (main pipe), the water is brought to a distributer. The size of the feed-pipe is determined by the quantity of water to be used. Twenty-two-inch (in diameter) mains are generally used in the larger hydraulic workings.

The pipes are made of wrought-iron, the thickness of which increases with the diameter of pipe, and the hydrostatic pressure to which the pipe is subjected, Nos. 16, 14, 12 (Birmingham gauge). These numbers correspond to thickness of .065, .083, 1.09 inches, respectively. To prevent the pipes from corroding, they are coated with a preparation of asphalt and coal tar. The pipes are made in lengths of twenty feet, and jointed together in stove-pipe fashion, rivets being rarely used.

The "distributer"* is a cast-iron box which serves the purpose of a hydrant, and by means of valves enables the partition of the stream of water and the diversion of the branch streams into two or more pipes, whereby more than one part of the gravel bank can be simultaneously hydraulicked.

From the distributer the streams are piped to the "monitors" or "giants." These are the discharge pipes which concentrate the stream and enable its projection upon any desirable point. The giants and monitors are labor saving. Before their introduction at North Bloomfield, there were ten to fifteen streams playing, while now one stream, tended by one man, does as much work.

The "nozzles" of the monitor are from four to nine inches in diameter. Two or more monitors are employed, depending upon the magnitude of the workings. The streams played upon the bank are one hundred or more feet in length. The large mines have a dozen or more monitors, but rarely have enough water to supply at once more than four or five monitors.

The disintegrating power of the jet, which at the larger mines equals one thousand to one thousand five hundred inches of water (one thousand five hundred to one thousand seven hundred and fifty cubic feet per minute), weighing sometimes upwards of one hundred thousand pounds, under pressure of one hundred and fifty feet to four hundred and fifty feet, is enormous. Yet, notwithstanding this, the gravel is sometimes so tenaciously cemented that assistance of powder becomes necessary to shatter or break up the bank preparatory to its disintegration by water.

It is desirable to get the monitor or giant as near the bank as is consistent with the safety of the miners and the machine, in order to obtain the full force of the stream. Where the banks are high—over two hundred feet or so—they are accordingly usually worked in benches of from one hundred and fifty feet to two hundred feet in depth.

The system of "bank blasting" generally in vogue is as follows: A small level, or drift, is run into the bank at right angles to the face of the bank, and from the end of this drift crosscuts are driven parallel to the bank (at right angles to the drift). The drifts will form a T-shaped excavation. The length of the main drift will vary from twenty to one hundred feet, and in the cross-drifts, of which there may be two (forming a ∓), the kegs of powder are placed. The cubical contents of the portion of the bank to be blasted, the tenacity of the material of the bank, etc., will determine the length of the powder drifts and the quantity of powder to be used. From a few dozen to a thousand or more twenty-five-pound kegs of black blasting powder* are ignited in one blast. The drifts are well tamped, and the charges are simultaneously fired by means, generally, of a high-tension electrical machine.

---

* Owing to the liability to break, and their unwieldiness, the cast-iron distributers have, in many places, been displaced by sheet-iron branch pipes, or tees, which have cast-iron gates.

Where the banks are worked in "benches" or stopes, vertical shafts ten to twenty feet deep are sunk from the surface of the deposit, short drifts are run from the bottom of the shaft, forming an inverted T (⊥), and the powder charged, tamped, and fired as above. Very much lighter charges are used in this kind of blasting. A slow lifting powder is generally used for bank blasting, while the nitro-glycerine explosives are used for blasting the bowlders, trees, etc., which were washed down into the pit or open space on the bedrock left after washing away the gravel, etc.

The second condition prerequisite to the successful working of the hydraulic mine is the attainment of the grade necessary for the treatment of the detrital material piped from the bank.

To get the requisite grade for the sluices, and, at the same time, to obtain a suitable place for the deposition of the debris from the washing out of the gravel bank, often involves the driving of a long bedrock tunnel.

The topographical features of the environs will determine the location of the tunnel. The mouth of the tunnel should be sufficiently below the bedrock of the deposit to be prepared for the contingency of a change in the grade of channel, whereby the tunnel might be placed above the level of the drainage and rendered practically useless. This difference of level also admits of the use of chimneys or shafts, connecting the surface of the bedrock of the channel with the face (interior end) of the tunnel, whereby a drop is obtained which facilitates the disintegration of the obdurate conglomerate. A line of sluices is laid in the tunnel.

The tunnels are from a few hundred to several thousand feet in length. The tunnel of the North Bloomfield Company, in Nevada County, is seven thousand eight hundred and seventy-four feet long, and its dimensions seven by eight feet. It cost about $500,000. The tunnels are from four to eight feet wide and from five to nine feet high.

The gradient to be given the tunnel will be determined by the fall available, the character of the material to be washed, etc. Tenacious material, such as very compact conglomerate, very indurated pipe-clay, etc., will require a high grade, and from ten to twelve inches per twelve feet would be advantageous.

The material "piped" from the bank is carried by the stream of water through bedrock cuts and sluices to the chimneys or shafts (where such exist).

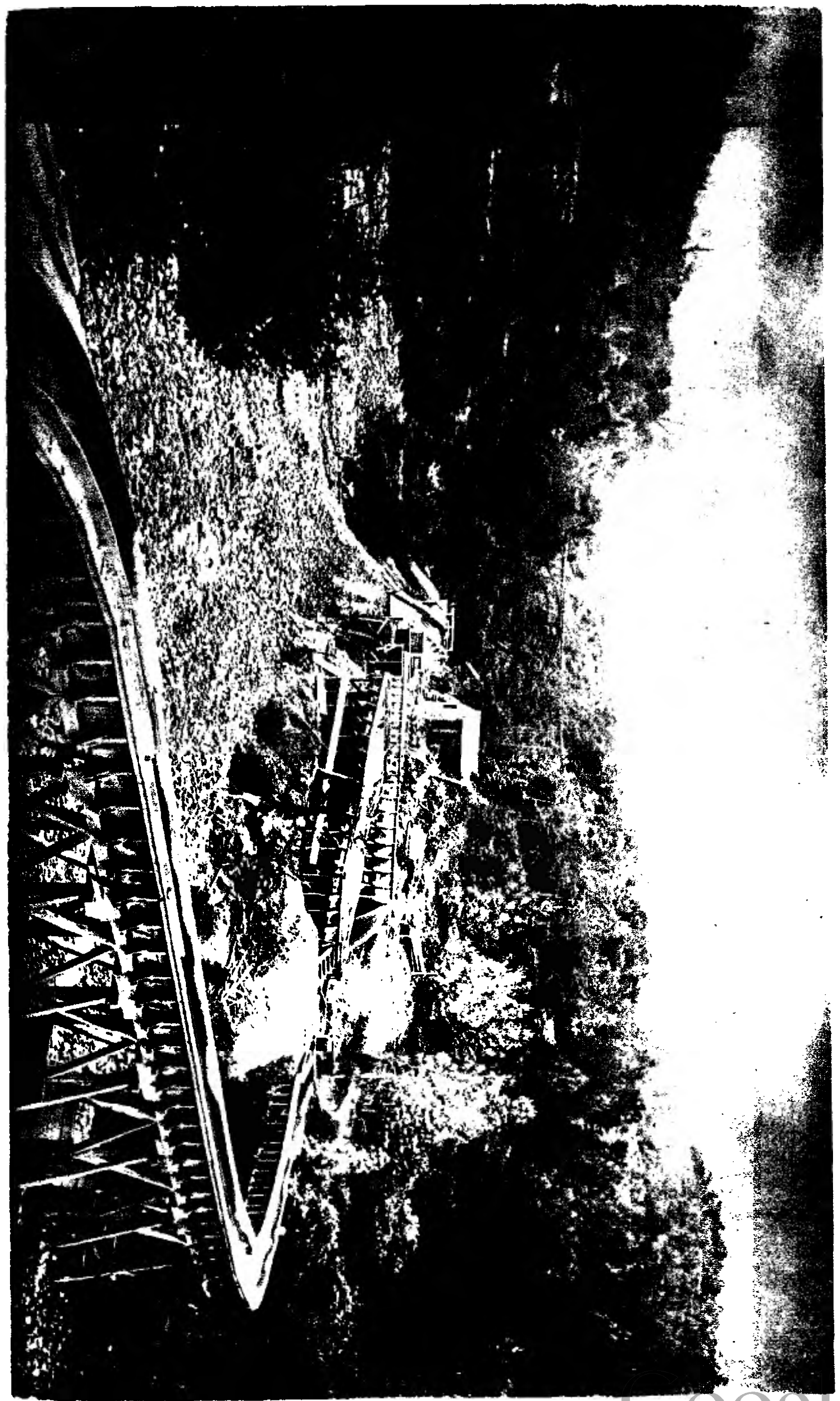
The bedrock cut, as its name implies, is a trench carried in the bedrock from the upper end of the line of sluices to the gravel bank. These cuts are about as wide as the sluices, and are sometimes twenty to thirty feet deep. The gravel is washed into these cuts and thus is brought to the sluices. These cuts are not paved. Cuts require nearly twice as much grade as sluices.

SLUICES.

These are commonly called "flumes" in mining parlance, but the term "flume" should be restricted in meaning to a conduit for carrying water to be used in hydraulicking, while the term "sluice" in contra distinction

---

* Low-grade dynamite powder has almost entirely superseded black powder in bank blasting.



SLUICE LINE CONSTRUCTED ON CURVE.

A straight line is, of course, preferable for sluices. In background are seen a grizzly and an undercurrent.

should refer to the boxes or troughs below the cuts through which the gravel is washed, and in which the gold is recovered.

These are a kind of water trough or box from three to six feet wide, and from two to three feet deep, and most generally twelve feet in length per box. From one hundred to several hundred boxes are used in a line of sluices.

PAVEMENTS.

To prevent excessive wear and tear of the sluices, they are lined with heavy planks on the sides and are paved with rocks and blocks which also serve as riffles to arrest the flow of the gold and amalgam. Iron rails ("T" rails from railroads), or wooden rails covered with bar iron, are placed longitudinally upon the bottom of the sluices and also serve as riffles.

Economic conditions will determine which of the styles of riffles are used. Rock riffles will wear longer than the other kind, lasting from three to six months, but require more grade to the sluices, and also a loss of more time in cleaning up and repaving the sluices.

Block riffles are made, where possible, of the "digger" pine (*Pinus sabiniana*) and other pine. Hard wood is not as good as the softer pine, which has the property of brooming up and thus presenting a better surface to arrest the gold and amalgam. They are square, varying in size from twelve to thirty inches, and in depth from ten to eighteen inches. The interstices of the pavement are filled with small stones. Block riffles last from two to four weeks in the average conditions of hydraulicking
Iron riffles considerably longer. Though more costly in the first instan
they are cheaper in the end, owing to their longer life and greater econo
of time in being changed.

GRADE OF SLUICES.

Where top and poor gravel is being piped it is desirable to ru
fast as possible. The grade upon which the sluices are set wi
lated by the available fall along the line of sluices, and by t
of the material washed. In some localities the adoption
grades two to four inches per box is enforced by lack of
does the use of such light grades greatly decrease the dut
involves a large increase in the expense of handling the
of being sluiced upon such grades. The grade in ge
known as a six-inch grade (six inches to a box of tw
practicable the use of grades from eight to twelve i
tageous. Steep grades facilitate the thorough
cemented gravel, and thereby effect a reduction
which would otherwise be necessary to insure t

It is best to have steep grades for the disin
depend upon the undercurrents to save such
ited on account of the grades of this charg
ally advisable where water is expensiv
several hundred and sometimes sever
"Loss of Gold.")

Some mines have a double line of
cleaning up and repaving sluices.

Sluices cost from $25 to $35 per
The Spring Valley Mine has thr
miles in length each.

GRIZZLIES AND UNDERCURRENTS.

When the available fall admits of it, one or more grizzlies and undercurrents are used along the line of the sluices.

A grizzly is a grating or framework of iron bars, laid parallel, with interstices between to allow the finer material to fall into the sluices, or undercurrents, below, while the coarser barren bowlders are screened off, as it were, and dumped outside of the flume.

It is desirable to get rid of the large bowlders as soon as possible, to prevent unnecessary wearing of the pavement of the sluices and waste of water in washing them; but where the gravel is much cemented the bowlders assist in its disintegration.

To remove the large bowlders (sometimes weighing several tons) from the bedrock and cuts, a kind of derrick crane is used. These bedrock derricks have a mast from eighty to one hundred feet high and a boom eighty to ninety feet long, and are modified in other respects to best adapt them to their employment in hydraulic mines. The actuating power of the derrick is, generally, a hurdy-gurdy. This is a peculiar kind of impact wheel, made to utilize water under high pressure. The water is projected through a nozzle tangentially to the wheel, upon the periphery of which are set radial buckets. The Pelton and Knight's wheels are examples. Under favorable conditions, the Pelton wheel will develop about eighty per cent of the theoretical power of the water.

The undercurrents are large boxes or tables, of various shapes and sizes, more commonly ten to twenty feet wide and forty to fifty feet long, which by the distribution of the water over larger surfaces makes the stream shallow and allows the deposition of the gold and amalgam upon the riffles with which they are paved. Block, rock, or iron riffles are used in the undercurrents. The fine material which falls through the interstices of the grizzly is usually carried to the undercurrents.

AMALGAMATION.

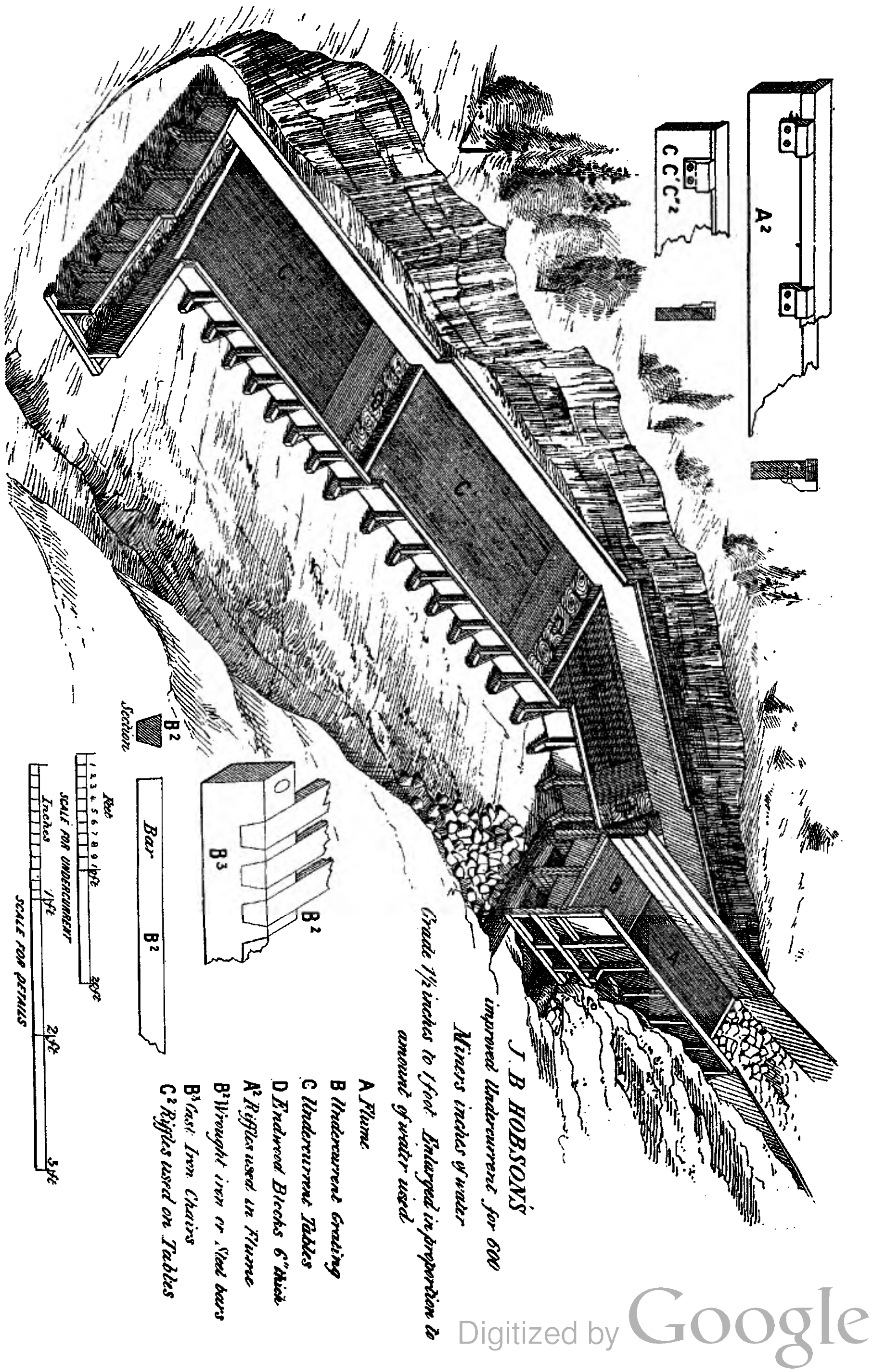
Quicksilver is added several times a day, in quantities depending upon the length of the sluices. The more quicksilver added the greater are the chances of catching the gold. The usual practice is to sprinkle the quicksilver in the sluices and undercurrents, the greater part being added near the head of the sluices. No quicksilver is added to the cuts. From the consistency of the amalgam, and the appearance of the quicksilver in the sluices (which are frequently inspected), the feeding of the quicksilver is regulated.

Two or four tons of quicksilver are often in process of manipulation at once at some of the large hydraulic mines, one part of it being in the sluices and another part on hand as amalgam. The upper portions of the sluices are cleaned up, generally once or twice a month, the middle portion less frequently, and the lower part only once a season.

With large "heads"* it is advisable to clean up frequently to prevent a loss of amalgam through prolonged trituration. The upper part of the sluices for a distance of about two thousand feet ought to be cleaned up about every two or three weeks, where large quantities of gravel are washed. A gang of miners can clean up and repave a thousand feet of sluices in a day and night.

---

[*] The term "head" is often used in this connection to express the quantity of water used, as, for example, a head of five hundred inches, etc. It must not be confounded with the hydrostatic head, which the miners commonly designate as "pressure."



J. B HOBSON'S improved Undercurrent for 600 Miners inches of water

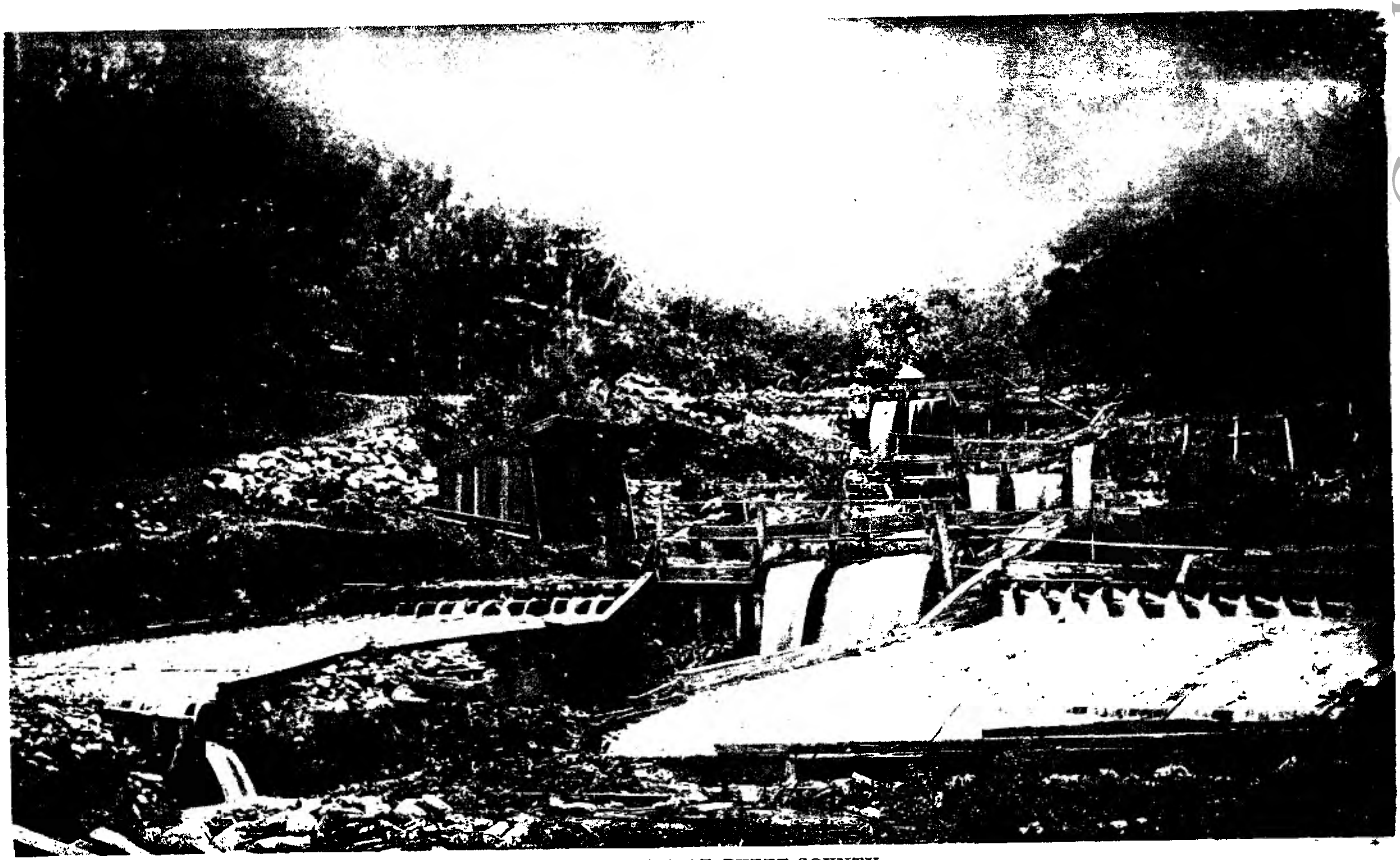
Grade 1½ inches to 1 foot Enlarged in proportion to amount of water used

DROP FOR DISINTEGRATING GRAVEL, AND UNDERCURRENT.

The material passing over the drop and that discharging from the undercurrent is taken up by sluices below.

METHOD OF CARRYING FLUME ACROSS CAÑON BY IRON BRIDGE.

Also grizzly for removing large bowlders. *Lack of room prevents introduction of undercurrent at this point.*



CHEROKEE FLAT, BUTTE COUNTY.

A nest of undercurrents. This company had twenty-four undercurrents along its line of sluices. Between the lowest two undercurrents is seen the griz-zly over which the coarse bowlders are washed, while the fine material which passes through the interstices of the grizzly is carried over the under-

CLEAN-UP.

In cleaning up the riffles are removed, a small stream of water is run over the sluices, and the gold and amalgam collected by scoops, etc. The amalgam is strained, cleaned, retorted, and melted. With the amalgam many of the minerals described before as existing in the gravels are found.

From 75 to 80 per cent of the total yield of amalgam is obtained in the first three hundred to four hundred feet of sluices. A small percentage of the gold, in the form of dust, comes from the bedrock cuts. The remainder of the gold recovered comes from the undercurrents and in the lower section of the sluices.

Total yield for the year 1877-78	$311,276 20
Near bank, from rock cuts in mine (dust)*	4.57 per cent.
Flume in tunnel (1,800 feet)	86.26 per cent.
Tunnel below flume (6.000 feet)	4.50 per cent.
Cut below tunnel (200 feet)	0.81 per cent.
Tail sluices (300 feet)	1.21 per cent.
From seven undercurrents	2.65 per cent.
	100.00 per cent.

The first undercurrent caught five times as much as the sixth, and nearly three times as much as the seventh undercurrent, which was of double size. This last yield, $947, induced the company to add another undercurrent.

The smaller mines use cup-shaped retorts, as used in the smaller gold mills, while the larger mines use retorts, such as are used in silver mills. Bullion from the hydraulic mines is notably very much finer than that from the quartz mines. This bullion will run from 850 to 980 fine. The bullion from the Australian gold gravels is much finer than that of California.

Silver is generally the debasing alloy, though where the grade of bullion is very low lead or copper are often found in the alloy. The value of the amalgam in the upper portions of the sluices is from $7 to $12 per ounce. The amalgam from the lower part of the sluices, from the undercurrents, is of less value, on account of the fineness (in texture) of the gold caught there. The amalgam from top gravel is poor for the same reason.

QUICKSILVER LOSS.

The loss of quicksilver is, under the average conditions, from 10 to 15 per cent of the quicksilver used; sometimes the loss is as great as 30 per cent, especially where the gravel is much cemented.

At the larger mines piping goes on night and day. Pitch bonfires are generally used to illuminate the works during the night, but at the North Bloomfield an electric light of twelve thousand candle power was used, and was found more effective and economical. At Cherokee two electrical lights, of eight thousand candle power each, are used.

GOLD LOSS.

The loss of gold in hydraulic mining varies according to the character of the gravel washed and the system of sluices, undercurrents, etc., in use. Where the gravel is a hard, tenacious, conglomerate some gold is liable to be carried away because of the imperfect disintegration of the gravel; also the presence of pipe-clay increases the gold loss. Where such gravel occurs it is desirable to disintegrate the gravel by blasting and by introducing, where practicable, numerous drops along the line of sluices. A long line of sluices with frequent drops and many undercurrents reduces correspondingly the gold loss. Of course, an appreciable amount of gold must inevitably escape as flour gold, rusty gold, and amalgam. Properly constructed undercurrents will diminish this loss, but still the last undercurrent of a series of many distributed over a long line of sluices (many miles in length) would undoubtedly catch some gold.

---

* No quicksilver is added in the cuts.

Other conditions not preventing, the length of the sluice system adopted is determined by the cost of the construction and of the maintenance compared with the value of the gold saved by reason of the increased length of the system.

No attempt has been made to introduce a system such as is employed in our best gold mills (see article on Gold Mills, Report State Mineralogist, 1888), to sample the tailings, and, therefore, it is difficult to approximate the percentage loss in hydraulicking operations. The examinations of many "tailings cañons," into which the debris from the gravel mines was washed, lead me to believe that but a small percentage of the gold is lost. It is often asserted that not more than one half of the gold in the gravel bank is saved by this method of mining. In the opinion of the writer, in most well conducted dydraulic and drift mining operations, at least 85 per cent and in many cases upwards of 95 per cent of the gold tenure of the gravel is saved. Mr. Louis Glass, formerly the manager of the Spring Valley Mines, is of the opinion that not more than five per cent of the gold passed off in the tailings.

TAILINGS.

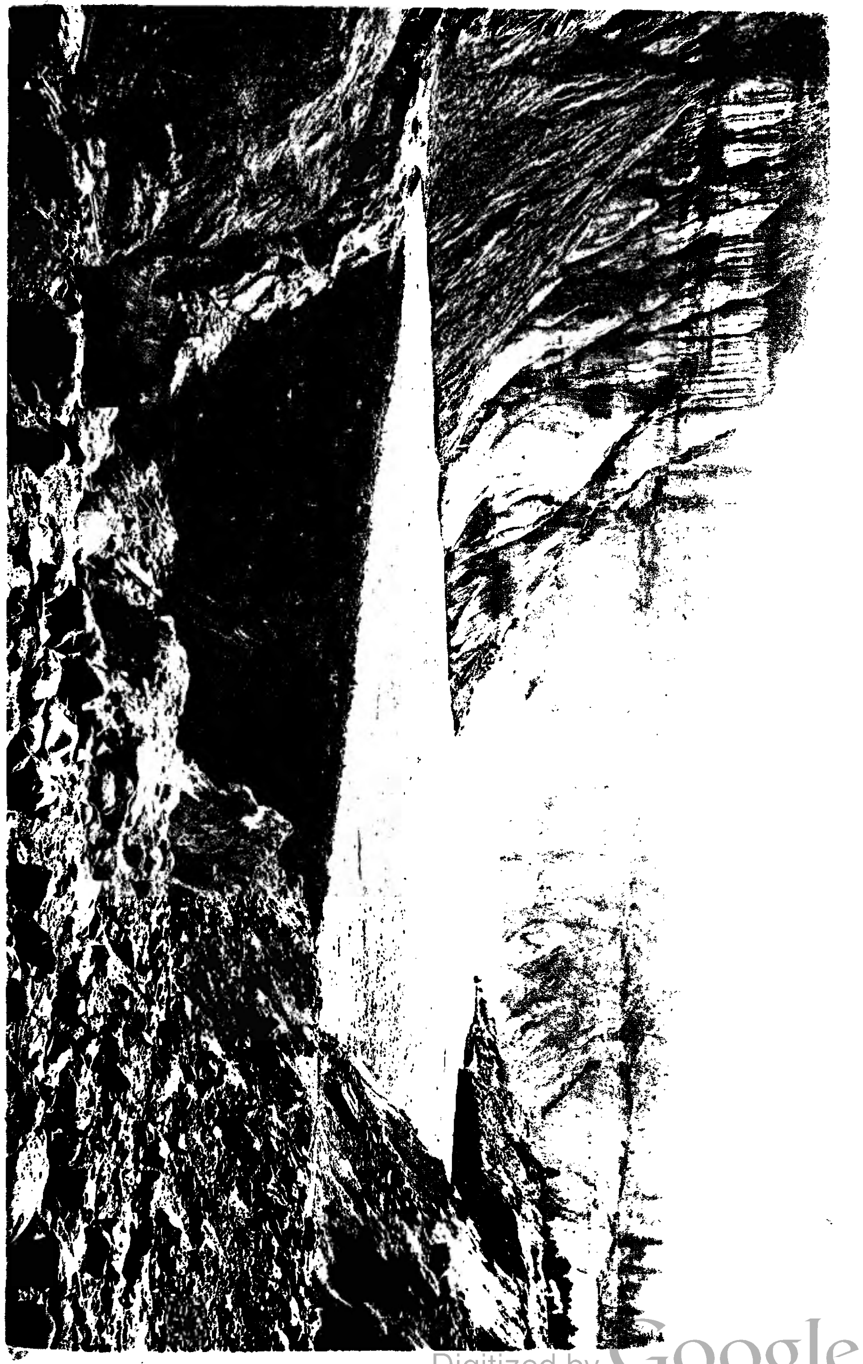
By far the greater portion of the material washed from the banks finds lodgment within a short distance of the tailings' dump of the mine. Fortunately the cañons into which most of the mines tail (*i. e.*, wash the debris) are of no value for purposes other than to serve as storage reservoirs for the mining debris. A properly constructed brush or log dam, preferably the former, for which most of the cañons below the mines afford advantageous sites, would, undoubtedly, impound nearly all the material which at present may be carried to the subjacent farming lands. Coöperative action in this matter, by companies having a common outlet for their tailings, would, in many localities, make it possible to operate their mines without damage to the agricultural or other interests. As these impounding dams become filled by the accumulated debris, they must be raised higher, or, if necessary, other dams must be constructed. But an insignificant amount of material would be carried over the dams as "slickens," in suspension into the valleys into which the cañons debouch. The cost of the construction and maintenance of a system of dams and of the canals for disposing of the "slickens" would be of no moment, as compared with the beneficial result of hydraulic mining.

EXTENT OF CLAIMS.

On account of the great expense usually attending the opening up of drift and hydraulic properties, and the low grade of the material to be mined, enterprises should be conducted upon a large scale. The larger drift or hydraulic mining companies own or control from one to five miles upon

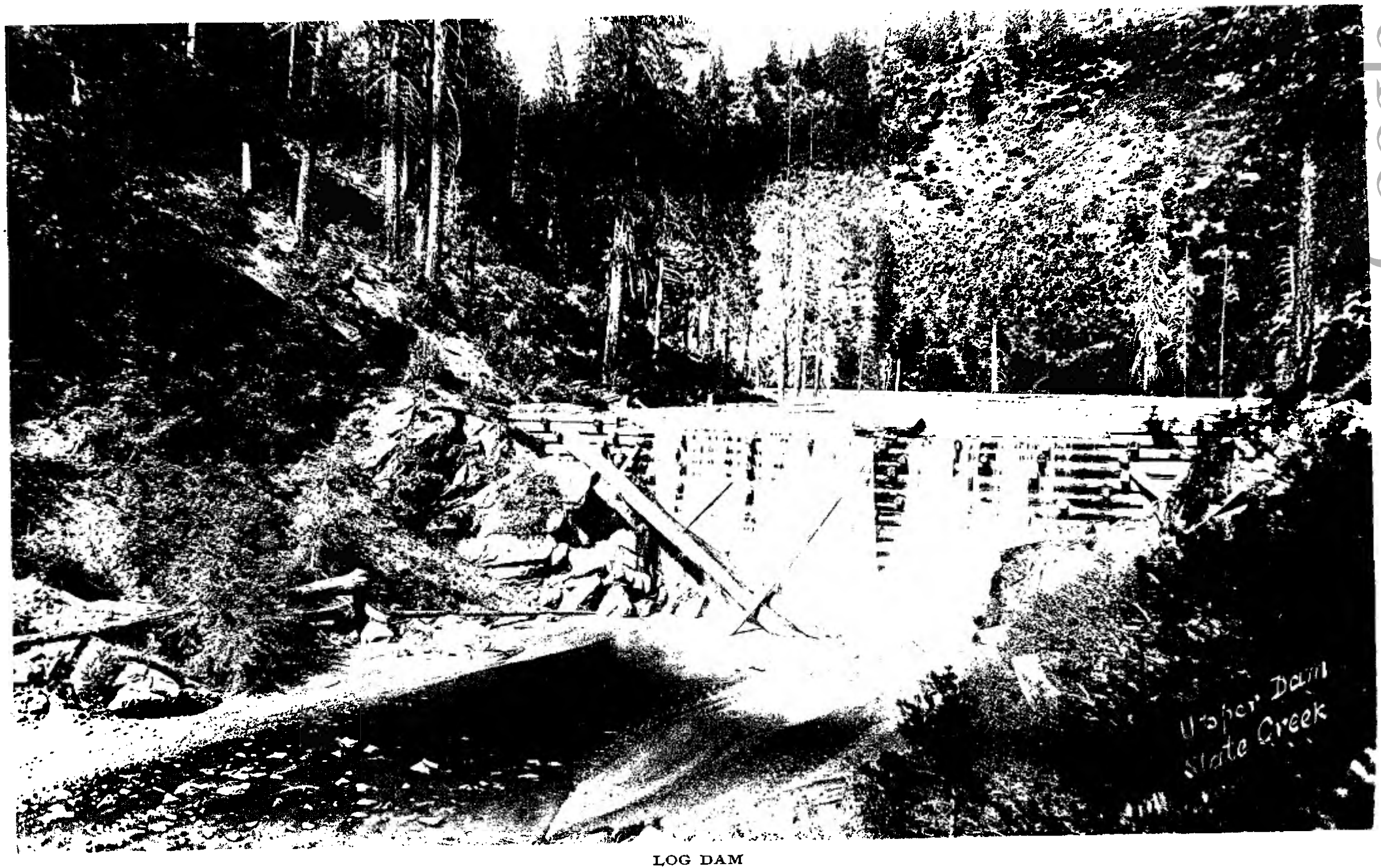
---

NOTE.—A bar of bullion from the North Bloomfield mine weighed five hundred and ten pounds and was worth $114,290. This is the largest gold bar ever cast in this country.



BRUSH DAM, NORTH BLOOMFIELD COMPANY.

For impounding tailings. Dam is in the washed-out ground. It is sixty-five feet high, and is raised as the tailings accumulate. The impounded tailings may be seen in the artotype.



LOG DAM

For impounding tailings from an hydraulic mine. The material behind the dam is tailings from an hydraulic mine.

the supposed course of the channel. Some have invested in the property and plant from $1,000,000 to $3,000,000.

LABOR AT MINE.

The larger drift and hydraulic mines work from seventy-five to one hundred and twenty-five men, with wages ranging from $2 to $3 50 per day.

YIELD OF GRAVEL AT HYDRAULIC MINES.

The value of gravel washed at hydraulic mines is estimated usually upon the basis of yield per cubic yard, per miner's inch of water used, or sometimes by the product per acre. A cubic yard of gravel is from one and one half to one and three fourths tons.

Resume of work done by the La Grange Company on all its claims, June 1, 1874, to September 30, 1876:

1,533,728 inches (2,159 cubic feet each) washed 2,275,967 cubic yards of gravel, which yielded 12,026.84 ounces. Troy = $231,893.

Disbursements.

	Total.	Per Cubic Yard.	Per Ounce Metal Produced.
Water	$17,307 62	$0.008	$1 43
Labor	82,345 70	.036	6 85
Material	21,788 35	.010	1 81
Official	11,244 94	.006	94
Contingent	3,125 80		26
Taxes	1,130 41		09
Totals	$136,942 82	$0.060	$11 38

Average value of the ounce of metal (gold and silver) produced	$19 29
Average yield per cubic yard of gravel	.1019
Average amount of gravel washed per inch, cubic yards	1.48

NOTE.—The reader is referred to the excellent treatise of Mr. A. J. Bowie, Jr., for additional data.

Yield of Gravel at Important Hydraulic Claims in California according to Verified Reports.

NAME OF CLAIM.	Location.	Cubic Yards Washed.	Gross Yield.	Yield per Cubic Yard.	Height of Banks in Feet.	Report of—	Remarks.
American Co.	Sebastopol, Nevada Co.	5,171,834	$1,241,240 30	$0 24	120	H. Smith, Jr.	
No. 8—1870-74	North Bloomfield, Nevada Co.	3,250,000	94,250 00	2.9	150	H. Smith, Jr.	Paid a profit of $2,232 84.
No. 8—1874-75	North Bloomfield, Nevada Co.	1,858,000	74,271 77	3.9	180	H. C. Perkins	The North Bloomfield produced, from 1867 to 1880, $1,435,680 47; the mining profits were $411,589 27. Hammond.
No. 8—1875-76	North Bloomfield, Nevada Co.	2,919,700	192,735 73	6.6	260	H. C. Perkins	
No. 8—1876-77	North Bloomfield, Nevada Co.	2,293,930	290,775 42	12.7	265	H. C. Perkins	
North Bloomfield	North Bloomfield, Nevada Co.	30,000,000	2,610,000 00	8.7	150-350	H. C. Perkins	
French Corral	French Corral, Nevada Co.	4,200,000	1,745,500 00	41.5	20-100	H. C. Perkins	The greater part of the top gravel had been removed previously.
Manzauita	Sweetland, Nevada Co.	5,780,000	1,489,000 00	26	50-150	H. C. Perkins	About one third of the top gravel had been removed previously.
McCarty's	Columbia Hill, Nevada Co.	3,000,000	345,663 10	4.3		J. D. Hague	
Sicard	Patricksville, Stanislaus Co.	155,347	20,197 07	13	38	J. Messerer	Top gravel.
Delaney	Patricksville, Stanislaus Co.					J. L. Jernegan	
Chesnau	Patricksville, Stanislaus Co.	27,250	11,009 00	40.4	18	A. J. Bowie, Jr.	
Chesnau	Patricksville, Stanislaus Co.	71,810	9,847 48	13	55	J. Messerer	
Chesnau	Patricksville, Stanislaus Co.	284,932	47,781 73	16	12-62	J. Messerer	Aggregate of 7 surveys checked by 1 survey, June, '74, to Oct., '76.
Chesnau	Patricksville, Stanislaus Co.	338,880	62,980 37	18.6	60	A. J. Bowie, Jr.	Includes the last.
New Light	Patricksville, Stanislaus Co.	667,347	45,511 81	6.8	35	A. J. Bowie, Jr.	Drifted previously in places.
New Light	Patricksville, Stanislaus Co.	683,244	45,444 65	6.6	24-60	J. Messerer	Aggregate of 5 surveys checked by 2 surveys.
Johnson	Patricksville, Stanislaus Co.	196,632	9,148 27	4.6	30	A. J. Bowie, Jr.	
New	Patricksville, Stanislaus Co.	17,796	773 72	4.3	42	A. J. Bowie, Jr.	
Kelley	La Grange, Stanislaus Co.	88,660	3,406 33	4	85	A. J. Bowie, Jr.	Result obtained from cleaning out a deep hole.
Kelley	La Grange, Stanislaus Co.	351,152	43,153 26	12.3	75	A. J. Bowie, Jr.	
Kelley	La Grange, Stanislaus Co.	701,685	15,770 34	2.2	100	A. J. Bowie, Jr.	Previously drifted; heavy blasting; no profit.
New Kelley	La Grange, Stanislaus Co.	161,032	8,852 31	5.5	40	J. L. Jernegan	Upper bench gravel.
New Kelley	La Grange, Stanislaus Co.	252,614	35,012 33	13.8	65	J. L. Jernegan	Top and bottom gravel.
New Kelley	La Grange, Stanislaus Co.	1,000,000	64,550 27	6.4	40-65	J. L. Jernegan	Includes the two last data.
French Hill	La Grange, Stanislaus Co.	252,614	35,136 72	13.8	45	J. L. Jernegan	Winter of 1876-77.
French Hill	La Grange, Stanislaus Co.	676,968	90,186 19	13.3	*10-48	J. Messerer	Aggregate of 5 surveys checked by 2 surveys, May, '74, to Oct., '76.
French Hill	***La Grange, Stanislaus Co.***	**1,020,347**	**188,433 11**	15.5	30	A. J. Bowie, Jr.	Includes the last and also early workings, of which portions had been previously drifted.
Light	La Grange, Stanislaus Co.	746,640	64,714 27	8.6	48	A. J. Bowie, Jr.	Banks contained several thick strata of sand.
Blue Point	Smartsville, Yuba Co.	93,944	115,728 17	1 23	57	H. Smith, Jr.	
Green Flat	Plumas Co.	22,000	15,000 00	67.5	15	A. J. Bowie, Jr.	
Fale's Hill	Plumas Co.	25,000	4,794 49	19	75	A. J. Bowie, Jr.	
Crawford's	El Dorado Co.	77,880	35,046 00	45	85	J. J. Crawford	
Gold Run District	Placer Co.	43,000,000	2,074,356 00	4.8	?	W. H. Pettee	

---

* Average thirty feet.

Yield of Gravel, including Smaller Hydraulic, Drift, and Cement Claims, according to Authorities Given.

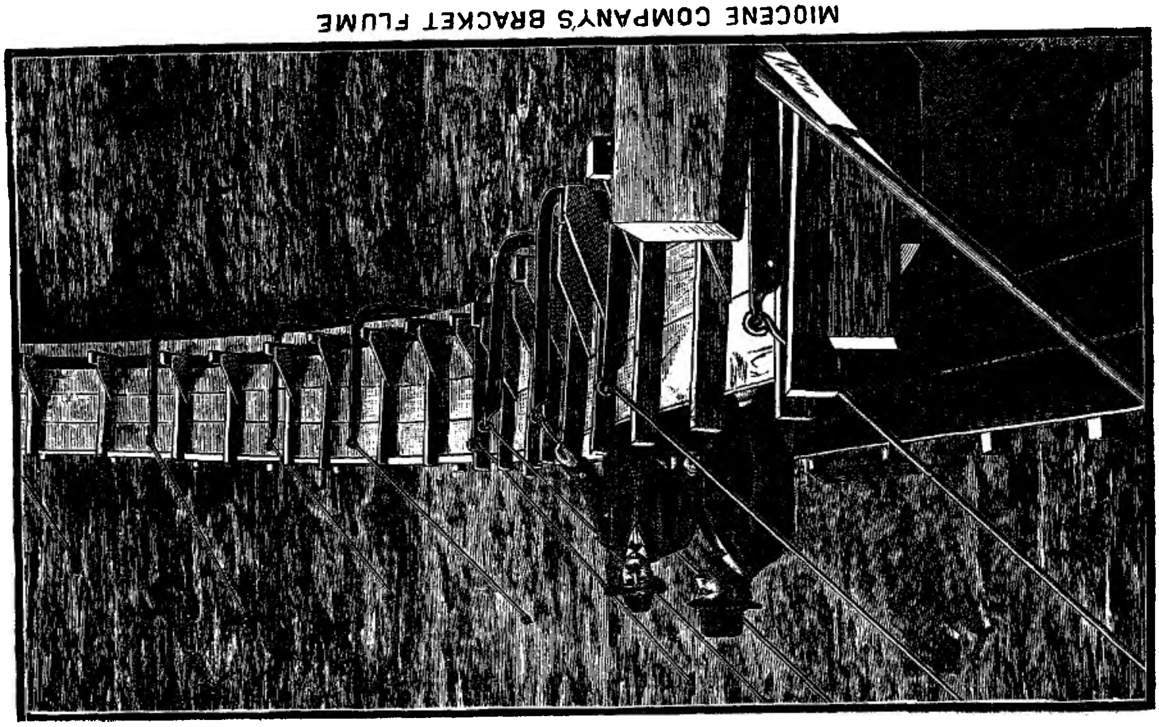
NAME OF CLAIM.	Location.	Cubic Yards Washed.	Gross Yield.	Yield per Cubic Yard.	Height of Banks in Feet.	Authority.	Remarks.
Bennet	Calaveras County	963	$1,320 00	$1 37	13	J. Rathget	Calculated from data in Raymond's Rep., 1872.
Johnston	Calaveras County	2,268	1,560 00	68.5	12½	J. Rathget	
Hedwick's	Calaveras County	2,963	1,450 00	48.5	20	J. Rathget	
Whiteside's	El Dorado County	9,722	100,000 00	10 28	70	Raymond's Rep., '75	Calculated from data, p. 84.
Nagler	El Dorado County	20,000	100,000 00	5 29	30	Raymond's Rep., '75	
Spanish	El Dorado County	1,422	13,600 00	5 00	4	Raymond's Rep., '75	
Blue Tent	Nevada County	5,138,150	780,000 00	15		Raymond's Rep., '74	Estimated by several engineers, p.19.
South Yuba (G.Hill)	Nevada County	632,533	79,699 15	12.6		Official Rec., 1876–77	W. H. Pettee. See "Contributions to Am. Geology," Vol. I., Whitney, p. 414.
South Yuba (G.Hill)	Nevada County	501,028	70,143 92	14		Official Rec., 1878	
Blue Lead	Nevada County	235,703	16,599 21	07	160–220	Official Rec., 1878	
Enterprise	Nevada County	1,398,963	28,818 63	02.06	150–300	Offici'l Rec., 1876–1878	Chiefly top gravel; fine, loose, and sandy material. W. H. Pettee. See "Contributions to Am. Geology," Whitney, p. 414.
Polar Star	Placer County	888,889	100,000 00	11		Colgrove Pettee	W. H. Pettee. See "Contributions to Am. Geology," Whitney, p. 425.
Quaker Hill	Placer County	388,888		06⅔			
Kansas	French Corral, Nevada Co.	67,500	223,000 00	3 30	27	H. Smith, Jr.	Cement claim.
Empire	French Corral, Nevada Co.	29,166	200,000 00	6 85	18	H. Smith, Jr.	The richest gravel selected and milled.
Nebraska	French Corral, Nevada Co.	(Tons) 600	9,000 00	*		H. Smith, Jr.	
Indiana Hill	Placer County	14,449	75,422 47	5 22		W. H. Pettee	See "Contributions to Am. Geology," Vol. I, Whitney, p. 425; also, Raymond's Rep., 1875, p. 100.
Pond	Placer County	255,933	91,828 30	35.8	50	W. A. Goodyear	"Contributions to Am. Geology," Vol. I, Whitney, p. 118.
Sailor's Union	Placer County	404,615	42,800 00	10.5	116	W. A. Goodyear	The bedrock yielded $124,598. "Contributions to Am. Geology," Vol. I, Whitney, p. 116.
Paragon	Placer County	124,000	92,000 00	74.2	70	Jos. McGillivray	
Paragon	Placer County	22,275	17,387 78	78	71	Jos. McGillivray	This deposit contained many large bowlders.
Dard'nell's and Oro	Forest Hill, Placer County	3,630,000	476,000 00	13.1	150	Jos. McGillivray	
La Porte	La Porte, Plumas County		87,000 00	3 13	30	Chas. Hendel	
La Porte	La Porte, Plumas County		57,500 00	20 87	6	Chas. Hendel	Drifted.
Secret Diggings	Plumas County		300,000 00	2 00	140	W. H. Pettee	
Gardner's Point	Plumas County	148,148	118,000 00	79	80	A. J. Bowie, Jr.	
Bean's Hill	Plumas County	314	220 00	70	5	A. J. Bowie, Jr.	Shallow spots.
Jack's Hill	Plumas County	740	37 37	05	8	A. J. Bowie, Jr.	
McDoran's	Plumas County	5,555	300 00	05.4	20	A. J. Bowie, Jr.	
French Hill	La Grange, Stanislaus Co.	16,368	9,782 98	61	18	R. Abbey	
Light Claim	La Grange, Stanislaus Co.	73,566	8,468 35	11.4	57	R. Abbey	
Bald Mountain Co.	Sierra County	115,950	328,352 38	2 83		Raymonds' Rep., '75	Deep placer-mining. Cubic yards estimated from coarse dirt washed.
Bald Mountain Co.	Sierra County	50,040	296,737 28	5 93		H. W. Wallace	From June 24, 1875, to June 24, 1876, 100,080 carloads of gravel mined, stripping 300,240 superficial feet of bedrock. Each car contained one cubic yard of loose gravel, equal to one half cubic yard of gravel in place.
Bald Mountain Co.	Sierra County	49,022	235,797 87	4 79		H. W. Wallace	Year ending June 24, 1877, 98,044 carloads extracted, stripping 343,768 superficial feet of bedrock.
Bald Mountain Co.	Sierra County		269,755 00			H. C. Perkins	1877–1878, 106,160 carloads extracted.
Bald Mountain Co.	Sierra County		164,904 00			H. C. Perkins	1878–1879, 90,274 carloads extracted.
Pioneer Tunnel	Sierra County	883	1,400 53	1 59		Chas. Hendel	One thousand one hundred and eighty-six feet of tunnel in gravel, ten to twenty feet above bedrock.
E. Gr'nd Dry Creek	Shasta County	50,000	9,000 00	18		Raymond's Rep., '74	
W. Side Dry Creek	Shasta County	2,000	741 26	37		Raymond's Rep., '74	
Piety Hill	Shasta County	1,333	22,000 00	16 50	20	W. K. Conger	Raymond's Report, 1874.
Dry Creek	Shasta Connty	200 lin. ft.	170,000 00			—. Cooper	
Smartsville	Sucker Flat, Yuba County	2,042,880	400,000 00	19.5	112	Amos Bowman	See Report on the Smartsville Blue Gravel and Excelsior Canal Co., pp. 32–35.
Union Gravel	Empire Hill	792,000	120,000 00	15	90	Amos Bowman	
Pactolus	Yuba County	1,468,800	295,000 00	20.8	85	Amos Bowman	
Blue Gravel	Temperance Hill, Yuba Co.	2,449,120	1,560,000 00	63	83	Amos Bowman	
Pittsburg	Temperance Hill, Yuba Co.	565,760	237,000 00	41	59	Amos Bowman	
Pactolus	Yuba County	60,000	26,600 00	44	50	W. Ashburner and J. D. Hague	

NOTE.—These compilations were made by A. J. Bowie, Jr., E.M.

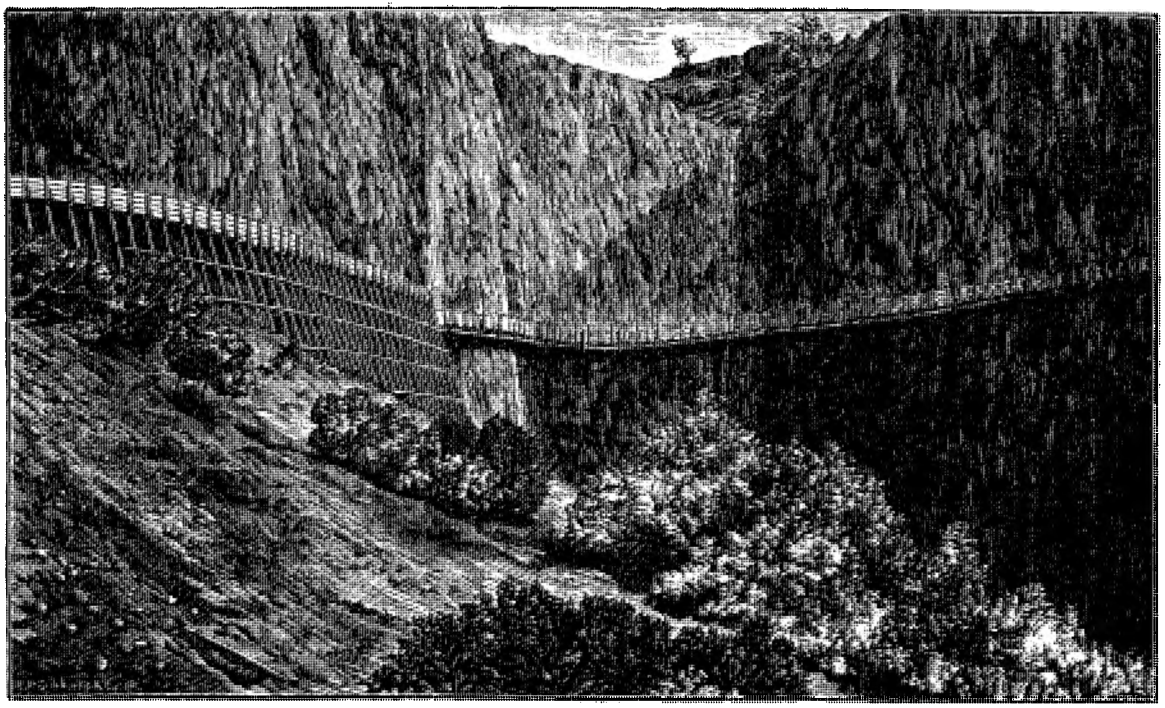
*$15 per ton.

Details of Work at No. 8 Claim, North Bloomfield Company.

	1874—1875.			1875—1876.			1876—1877.		
	Total.	Per Cubic Yard.	Per Inch of Water.	Total.	Per Cubic Yard.	Per Inch of Water.	Total.	Per Cubic Yard.	Per Inch of Water.
Cubic yards of gravel moved	1,858,000	....	4.8	2,919,700	....	4.17	2,293,900	....	3.86
Yield	$74,271 77	3.99 cents	19.19 cents	$192,735 73	6.60 cents	27.53 cents	$290,775 42	12.68 cents	48.87 cents
Expenses—Labor	$22,790 39	1.23 cents	5.89 cents	$40,975 85	1.40 cents	5.85 cents	$53,742 78	2.34 cents	9.03 cents
Explosives	2,944 94	0.16 cents	0.76 cents	10,279 73	0.35 cents	1.47 cents	25,376 16	1.11 cents	4.26 cents
Blocks	3,007 26	0.16 cents	0.78 cents	5,212 62	0.18 cents	0.75 cents	5,750 43	0.25 cents	0.97 cents
Material	5,663 89	0.30 cents	1.46 cents	9,250 46	0.32 cents	1.32 cents	10,158 72	0.44 cents	1.71 cents
Water	14,480 40	0.78 cents	3.74 cents	21,740 97	0.75 cents	3.11 cents	21,765 88	0.95 cents	3.66 cents
General	4,201 95	0.23 cents	1.09 cents	7,364 12	0.25 cents	1.05 cents	25,266 11	1.10 cents	4.25 cents
Totals	$53,088 83	2.86 cents	13.72 cents	$94,823 75	3.25 cents	13,55 cents	$142,060 08	6.19 cents	23.88 cents
Days run	295; com. Jan. 1, end. Oct. 14.			342; com. Nov. 13, end. Oct. 18.			318; com. Nov. 26, end. Oct. 13.		
Grade of sluices	6½ inches to 12 feet.			6½ inches to 12 feet.			6½ inches to 12 feet.		
Height of banks	180 feet.			260 feet.			318 feet.		
Inches of water	386,972.			700,000.			595,000.		



MIOCENE COMPANY'S BRACKET FLUME



BRACKET FLUME AND TRESTLE. MIOCENE COMPANY.

SAN DIEGO COUNTY.

Recent Work by W. A. Goodyear, Geologist, Assistant in the Field.

MONTMORILLONITE, OR "MINERAL SOAP."

Near Mr. Jackson's house, on the eastern edge of the National Grant, and about three miles northeast from the village of Otay, in San Diego County, there occurs in the mesa formation a bed of montmorillonite, a hydrous silicate of alumina, containing a far higher percentage of water than is the case with ordinary clays, the moisture constituting a little over one fourth its entire weight. It is quite soft, some of it white and some of it red in color, and has an extremely unctuous or saponaceous feel, which has caused it to be locally designated in the region about San Diego by the name of "mineral soap." It appears to form a nearly horizontal bed, varying from three to four inches to two or three feet in thickness, intercalated between the other beds of the mesa at a depth of from forty to fifty feet below the general level of the surface. It also appears to be of considerable extent, as it is exposed in cañons at two different localities about a mile apart, and is said to have been pierced at numerous other points by wells that have been sunk in the mesa.

By reference to the map, it will be seen that the Otay and the Jamul Creeks are one and the same stream, the former name applying to its lower portion, where it passes through the Otay Grant, while for a similar reason its upper portion is called Jamul. Following the road up the valley of this creek, the "mesa formation," consisting of nearly horizontal beds of gravels, sands, and clays, continues to form the whole surface of the country for a distance of some ten miles from the village of Otay. But it there stops, and for several miles beyond the country consists mainly of dark colored, very highly metamorphosed, and extremely hard conglomerates, in which very few traces of their original stratification can now be seen. And, indeed, it is not improbable that some of these rocks may really be of igneous eruptive origin.

JAMUL GRANT CEMENT ROCK.

On the Jamul Grant a rock has been found from which a good article of hydraulic cement has been manufactured. This rock is an argillaceous calcareous tufa, and has been deposited here in past ages by mineral springs, which have long ceased to exist. It has been sufficiently prospected by a number of holes sunk from four to ten feet deep, and irregularly scattered over an area a quarter of a mile or more in diameter, to prove that its quantity is large. The country rock about here is mostly a very hard and tough, dark gray, and sometimes almost black porphyry, of which the ground mass, as well as the imbedded crystals, consist of feldspar.

The waters of the hot springs, which must have continued to exist for a very long period subsequent to the eruption of the porphyry, slowly decomposed the rock in depth, and afterwards on emerging to the air deposited most of their lime with a portion of the alumina in the form of this tufa. Numerous bowlders of the still undecomposed porphyry are imbedded in the tufa, and many of them are coated over with a tightly adhering crust of lime, which has been deposited upon them. This porphyry covers a large area of country about here, stretching easterly through the hills on both sides of the Jamul Creek for a distance of some eight or ten miles before the granitic rocks begin to make their appearance.

COTTONWOOD CREEK AND CAMPO.

Beyond this, for a distance of some three or four miles along the road towards Cottonwood Creek, the rocks are extremely varied in character, and mixed in great confusion. Large patches of granite and porphyry occur irregularly scattered about, with other patches of very hard, dark-colored, and highly metamorphosed conglomerates and breccias.

The granitoid rocks themselves also vary enormously both in texture and composition, and graduate all the way from a true granite through syenitic granite and syenite to a nearly black rock consisting mainly of hornblende and containing little or none of the constituents of true granite. Many of them contain considerable magnetite in fine grains.

A rock also occurs, consisting almost entirely of quartz and feldspar without appreciable quantities of either mica or hornblende. Most of these rocks are very hard. But some patches were seen of decomposed granite which was red and soft.

Some two or three miles before reaching Cottonwood Creek, however, the porphyries and the metamorphic rocks mostly disappear, and the country becomes almost exclusively granitic.

Bunches and veins of quartz occur here and there which not infrequently contain tourmalines.

Some two miles west of Cottonwood Creek, two different parties were said to be prospecting for gold in the granite, but their claims were not visited.

The country from Cottonwood Creek to Campo is granite, which in at least one locality, just south of Potrero, shows strong indications of having once been stratified, the direction of strike being about north 70 degrees west magnetic, and the dip nearly vertical.

There are said to be some new gold discoveries in the mountains some fifteen or sixteen miles east of Campo.

BUCKMAN'S SPRINGS.

At Buckman's house, some eleven miles northwest from Campo, there are three or four small mineral springs, from which considerable water has been bottled and sold by Mr. Buckman.

The water of these springs strongly resembles that of many of the springs in Lake and Napa Counties. It contains large quantities of free carbonic acid gas, and also a good deal of iron, which, on exposure to the air, is deposited in the form of sesquioxide. One spring produces water which is slightly purgative in its effects, and another one either now is or at some past time has been highly charged with lime, as it is surrounded by a considerable deposit of calcareous tufa.

Continuing northwesterly over the mountains from Buckman's to Pine Valley, the rocks are still granite. But a little beyond the summit there are very large quantities of quartz, which, however, seems to occur here not so much in veins as in irregular, though sometimes very heavy masses.

PINE VALLEY.

Pine Valley, like many others scattered through the mountains, is filled to depths of from ten to fifty feet with recent horizontal beds, through which the streams have still more recently cut deep channels down in places to the underlying solid granite. The valley was undoubtedly a lake while the horizontal beds were accumulating, and has since been drained by the stream which formed its outlet, having gradually eroded its channel deeper into the rocks.

PINE VALLEY MINING DISTRICT.

Within the past year some rich gold quartz has been discovered in the mountains a few miles northeast of Pine Valley. There are two groups of claims here, situated about three miles apart, where considerable prospecting has been done. The first, and up to date of visit (viz., late in October, 1889), the most promising of these groups is on Section 17, Township 15 south, Range 5 east, S. B. M. The other one is on Section 31, Township 14 south, Range 5 east, S. B. M., and very near the boundary line of the Cuyamaca Grant. The last of these two groups, called the Deer Park District, was first examined.

Here was found a sort of network of veinules and bunches of quartz running in all directions through a mass of decomposed granite. Most of the veinules are quite small, ordinarily not over six or eight inches thick, while none were seen with a thickness of more than two feet. The whole formation is extremely irregular, and a veinule often, after running a short distance, suddenly stops and gives out altogether in the granite. Small, irregular, and isolated bunches of quartz are also common. Much of the quartz of the veinules is more or less distinctly laminated. None of this quartz had yet been worked in either mill or arrastra, and the developments up to that time consisted of a dozen or more small holes sunk at various points to depths, none of which exceeded twelve or fifteen feet. The only testing of the quartz, so far as learned, had been done with the pan and the horn spoon; but estimates thus made ranged from $12 to $20 per ton, and though no single body of quartz of any considerable magnitude had been found, yet there was talk of the immediate erection of a ten-stamp mill; and in favor of this project are the two facts, that wood is plenty and that plenty of water can also be easily obtained for such a mill, whether it can be supplied with paying ore or not. The altitude above the sea cannot be far from four thousand six hundred or four thousand seven hundred feet. Some of the white quartz here contains considerable tourmaline. Free gold is very rarely visible to the naked eye in the quartz at this locality, though one or two specks were seen.

Outside of this network in the soft granite some work had been done on two or three veins in hard, dark colored rocks in the near vicinity, but nothing of importance yet discovered there.

On Section 17 of Township 15 south, Range 5 east, S. B. M., the most promising thing yet discovered was the Eureka Vein, owned by the Noble Brothers and their partners. It is situated about four thousand nine hundred and fifty feet above the sea, and is a small vein, ranging from two or three to ten or twelve inches in thickness. It strikes north 40 degrees west magnetic, and dips 78 degrees northeasterly. It was prospected by an open cut driven northwesterly some thirty-five or forty feet on the course of the vein, the face of the cut at the end being about fifteen feet high. The walls on both sides are soft, decomposed mica-slates, which strike about north 30 degrees west magnetic, and dip northeasterly at about the same degree as the vein, which latter, therefore, cuts the slates at a small angle of about 10 degrees. One and one half tons of quartz from this cut, worked in an arrastra, yielded the Noble Brothers $140, and the arrastra tailings from this same lot still assayed over $50 per ton.

Altogether they had actually taken out of this little cut alone something over $200, some of which was very rich specimen rock. A thin layer of the slate itself adjoining the footwall is also often rich in free gold.

At a point in the cañon, one half or five eighths of a mile south 40 degrees east magnetic from the mine, and some eight hundred feet below it, the Noble Brothers had just about got a two-stamp mill, to be run by water power, completed, ready to start up about November 1, 1889. The two brothers were doing most of their manual labor themselves; and the present writer is well pleased to note their prudence, and to remark that, in his opinion, their prospects, by beginning thus in a small way, with such an outfit, and such a vein, were very good. From this open cut on the Eureka Vein, the South Cuyamaca Peak (the highest one) bears north 68 degrees west magnetic, and Emery's place in Pine Valley bears south 25 degrees west magnetic.

About a quarter of a mile south 70 degrees east magnetic from the mill of the Noble Brothers is the Mollie G Claim, on a vein of quartz in decomposed mica slate. It strikes about north 10 degrees east magnetic, and near the surface dips about 10 degrees easterly. A slope had been sunk sixty-five feet on the vein in a direction south 50 degrees east magnetic, and at the bottom of this slope the dip had increased to about 35 degrees. The vein ranged from one to four feet in thickness.

It is said that all of it prospects more or less in free gold, and that an assay has yielded as high as $30 per ton. Two or three hundred feet northeasterly from here, a shaft has been sunk twenty feet on the same vein, where the quartz is about three feet thick, and prospects fairly well. The altitude of the mouth of the slope by aneroid barometer is about four thousand four hundred and fifty feet. Some five or six hundred feet magnetic east from this slope of the Mollie G, and perhaps one hundred feet higher up the mountain is the Wilcox Claim, said to be on a vein of quartz from four to five feet thick, which strikes northeasterly and stands nearly vertical in mica slate. Very little work had been done, however, on this claim; not enough to show what the vein really is. It is said to have assayed $64 per ton, but Thomas Noble thinks it will average between $12 and $15.

Some five hundred feet northerly from the mouth of the Mollie G slope, and on the north side of the cañon, two or three short tunnels, fifteen or twenty feet long, had been driven on the Acme Claim, where three small and nearly parallel veins, from one to two feet thick, strike northwesterly and dip about 45 degrees northeast.

These veins are also in the soft, decomposed mica slates, the stratification of which they intersect at angles of 30 degrees to 40 degrees, the veins bearing more to the west of north than the slates. The high peaks a quarter of a mile distant to the east and northeast from the Mollie G are solid granite.

About eleven hundred feet north 56 degrees west magnetic from the Eureka Mine, is the Bay View Claim, where a very different class of ore occurs in a very different kind of country-rock. A vein of quartz about one foot thick here strikes northeasterly, and dips steeply to the northwest. The inclosing rock is fine grained, dark colored, heavy bedded, and very tough and hard. It is most probably metamorphic, though it may possibly be of eruptive origin. Some of the quartz in this vein is very rich in coarse, free gold. But it also carries considerable magnetite, some pyrite, a little galena, and a good deal of mispickel, thus being on the whole a decidedly complex ore, which will require special and peculiar treatment for its thorough beneficiation. None of this ore had yet been worked, but a tunnel had been driven on it some thirty or forty feet.

Along the road from Emery's, in Pine Valley, past Farley's Summit ranch, through the Guatay Valley, and so on up to Stonewall, the country is almost exclusively granitic and syenitic.

STONEWALL MINE.

If the lines of the United States land surveys were extended across the Cuyamaca Grant, the Stonewall Mine would be found to be located just about the center of the east half of Section 4, Township 14 south, Range 4 east, S. B. M. And it is on a small peninsula which projects northwesterly into the Cuyamaca Reservoir from about the middle of its southeastern side. It is also immediately at the northeastern foot of a little hill whose summit is about one hundred feet higher than the mouth of the main shaft. The following bearings were taken at the mine: South Cuyamaca Peak, south 26 degrees west magnetic; Middle Cuyamaca Peak, south 71 degrees west magnetic; North Cuyamaca Peak, north 40 degrees west magnetic. About three quarters of a mile south 10 degrees east magnetic from the mine is a sharp granite peak, which is probably eight hundred feet higher than the mine, called the Stonewall Peak, and is a prominent landmark for many miles around.

On October 30, 1889, the main shaft of the Stonewall Mine was four hundred feet deep. From the bottom of this shaft a level had been driven for some distance in both directions (*i. e.*, northwest and southeast), and some cross-cutting had also been done at various points. On the third level northwest of the shaft a very large body of ore was exposed for a distance of about one hundred and thirty feet along the drift with varying thickness, which in places was seen to be more than twenty feet; and the face of the drift was still in a very heavy body of quartz. Between the third and second levels the whole of this mass of ore remained almost solid in the mine, very little of it having yet been stoped.

But on the second level it is not so extensive nor so large as it is on the third level. From a portion of this same body of quartz taken from above the second level, they once made a run of $26,000 in one month, being the best single month's run ever yet made with the present ten-stamp mill.

They are now building a new twenty-stamp steam mill, which they expect to have completed and ready to start up about the first of January, 1890. The Superintendent, Mr. Waldo S. Waterman, stated that he then had about one thousand tons of ore already broken and lying loose in the mine, and that the total quantity of ore then in sight would be sufficient to keep all thirty stamps running steadily for at least a year, even if no more should be discovered within that time.

GOLD KING AND GOLD QUEEN.

At the Gold King and Gold Queen Claims, short notices of which may be found on pages 513 and 520 of the eighth annual report, some further work has been done. A slope has been sunk on the Gold King, with a pitch of 65 degrees in a direction north 68 degrees east magnetic, to a depth of eighty or eighty-five feet. And on the Gold Queen a vertical shaft has been sunk about sixty feet. The vein at the bottom of the Gold King is said to be from twelve to eighteen inches thick. No drifting has yet been done in either mine. But Messrs. Feeler & Melrose, the owners, state that one lot of about fifteen tons of quartz, which they had crushed at the Ready Relief Mine, at Banner, yielded them a little over $100 per ton, and that altogether, up to November 1, 1889, they have taken out about $1,900 from the quartz obtained in sinking these two little holes.

IRON ORE.

Half or three quarters of a mile north of the Gold King Mine, is a belt of country said to be several miles in length in a northwesterly and southeasterly direction, over which have been found scattered bowlders and fragments of iron ore, some of which are rich enough to be of value in a country where it would pay to smelt iron. But nothing has been done towards its development here. Also, at a point near where the road coming from the Gold King Mine meets the road going towards Julian, a small quantity of copper ore has been found, but not sufficient hitherto to prove of any value.

Samples of iron ore were also obtained from a vein of hematite, said to be twelve to fifteen feet thick, situated in Eagle Peak Cañon near the corner between Sections 34 and 35 of Township 13 south, Range 2 east, and Sections 2 and 3 of Township 14 south, Range 2 east, S. B. M. Mr. Arthur Juch, of Julian, is the owner of the claim on this vein.

JULIAN DISTRICT.

The statement on page 520 of the eighth annual report, line five from the top, that between Julian and Banner a broad belt of granite intervenes, is an error into which the writer was led by the fact that the wagon road over which he traveled from Julian to Banner, following the cañons and being very crooked, goes outside of the slate belt and passes for several miles over the granite country northeast of it. But as a matter of fact, the slate belt itself is continuous, not only all the way from Julian to Banner, but also for five or six miles at least southeasterly from the latter place.

Work has been lately resumed in quite a number of the mines in the immediate vicinity of Julian and some very rich ore has been discovered, and altogether, at the present writing (November, 1889), it certainly looks as if the district were on the eve of another and very successful career of development.

OWENS MINE.

At the Owens Mine, which had stood idle for many years, the ten-stamp mill has been repaired and put in good order, and the old vertical shaft, which had formerly been sunk to the depth of three hundred feet, has been pumped out, and retimbered, and sunk fifty feet deeper. No drifting had yet been done when the mine was visited on November first, but all indications, so far as they went, looked favorable. At this mine there were two separate veins, known as the Owens Ledge and the Red Ledge. The latter lies a little to the northeast of the former, and near the surface of the ground they were about twenty feet apart. The strike is about north 70 degrees west magnetic, and the dip some 80 degrees to the northeast. The Red Ledge has only been worked down to the two hundred-foot level, but the Owens Ledge was worked down to the three hundred-foot level for a distance of probably between three hundred and four hundred feet along its strike, most of this distance being southeasterly from the shaft. Both ledges are said to have averaged about thirty inches in thickness.

James Kelly, who first worked this mine, and went down three hundred feet, is said to have stopped work about 1873. The mine then lay idle until 1884, when the Owens Consolidated Company took hold of it, discovered the Red Ledge, and worked on that alone until August, 1887, when they stopped, and the mine was idle again until the present year. The mine makes some water, but its quantity is not great. The wall rocks are a fine grained, dark blue, micaceous and argillaceous slate, containing considerable pyrites, and strongly resembling the rocks which accompany some of the richest mines in the more northern counties of the State. The total yield of this mine in the past is estimated by those most familiar with its history to have been something over $300,000.

WASHINGTON MINE.

The Washington Mine, which corners on the Owens towards the southeast, was the first mine discovered at Julian, on the twenty-second of February, 1870. A tunnel was driven some distance northwesterly into the hill, and some very rich rock taken out. Two little shafts, about seventy-five feet apart, were then sunk to a depth of about seventy feet, and the ground between them worked out. This was the extent of the workings in this mine. The vein was small, ranging from two inches to two feet thick, but in places very rich. The rock in the bottom is said to be very hard, and there also they struck some water, which the owners, being poor, were unable to handle, and so were compelled to stop. Mr. Dilks is now reopening this mine, and had just about got the water out of it to the bottom of the old works on November first.

CHIEFTAIN MINE.

The Chieftain Mine lies a little northeast of the Owens. Here a tunnel has been driven about one hundred feet south magnetic to a small vein, which is said to pay from $15 to $85 per ton. A lower tunnel has also been driven here one hundred and eighty-four feet towards the vein, which it still lacks seventy-five or eighty feet of reaching. Work was progressing here when the mine was visited.

The Eagle Mine adjoins the Washington and Chieftain towards the east, but nothing was being done there.

HELVETIA MINE.

The Helvetia Mine, located, perhaps, one mile easterly from Julian, is one of the old and noted mines of this district. It also had been idle for a number of years, but has recently changed hands, and is now being reopened.

At the mouth of the mine very thin-bedded argillaceous shales strike north 75 degrees west magnetic, and dip 70 degrees northeast. A tunnel driven in here, southeasterly on the strike of the slates, encounters the old workings at a point two hundred and ten feet from its mouth, and about seventy-five feet below the surface. There are bunches and small stringers of quartz almost the whole length of this tunnel; but the stringers are not continuous. They range from an inch or less to eight or ten inches thick.

Now and then they suddenly run out entirely, while other stringers now and then as suddenly make their appearance on one side or the other of them in the slates. Two or three isolated bunches of quartz were seen that were five or six feet thick. But these larger bunches are said to be often comparatively poor ore, running from $12 to $15 per ton, while some of the narrow stringers are very rich, often running $75 or more per ton.

The old works are said to have been three hundred and ten feet deep below the surface of the hill, and at the bottom to have extended about four hundred feet along the vein, which was there from two to five feet wide, and averaged $18 per ton. At the mouth of the tunnel a new shaft has been sunk about one hundred feet, with a streak of quartz all the way down which averages about ten inches thick, and runs about $20 per ton. They struck water in this shaft at about eighty feet, but the quantity as yet is small. In the tunnel the slates are generally soft, and can be worked with the pick alone. But in the shaft they have some very hard and tough, though still thin-bedded rock.

From here the San Diego Mine bears about north 70 degrees west magnetic, distant perhaps half a mile, and the Owens Mine bears north 80 degrees west magnetic. The Helvetia Mine is said to have produced in the past about $480,000.

SAN DIEGO MINE.

The San Diego Mine was not entered by the writer, but work was also progressing there, and a shaft had been sunk, said to be then one hundred and forty feet deep, with a vein of quartz ranging from almost nothing up to five feet in thickness, and averaging about $15 per ton.

BIG BLUE CLAIM.

On the Big Blue Claim, the owner, Mr. Robert Gardiner, had driven a tunnel south 20 degrees west magnetic, about one hundred and forty feet into the hill, and among the last days of October, 1889, had struck at its face a bunch of quartz not yet sufficiently opened to show its form or size, but which can already be seen to be not less than two feet thick at this particular point, much of it being extremely rich specimen rock which would yield thousands of dollars per ton in coarse, free gold.

FRACTION CLAIM.

About one quarter of a mile northwest of the Ready Relief Mine, at Banner, is the so called Fraction Mine. Here a tunnel follows a small vein three hundred and twenty-two feet northwesterly into the hill. The vein runs from one inch or less to two feet or more in thickness, the pay streak averaging about fourteen inches thick. About sixty feet northeast of this vein there is another one which is about two and one half feet thick. A shaft has there been sunk to a depth of sixty-five feet below the tunnel, and considerable ore stoped out down to that depth. The vein in the bottom of the shaft is about twenty inches thick. This is on the so called Knelly or southwest vein. Northeast of this lies the Cable Vein. The poorest crushing yet worked from the Fraction Mine is said to have yielded $40 per ton, while its general average has been something over $100 per ton. About four hundred feet southeasterly from the Fraction Mine, and on the Cable Vein, a shaft was once sunk eighty feet, with the vein in the bottom of it from three to four feet thick, the quartz running from $65 to $150 per ton. For some distance to the southeast of this shaft the ground has been worked out down to the level of the bottom of the shaft. But towards the northwest no work of any importance has yet been done below the level of the mouth of the shaft.

HIDDEN TREASURE MINE.

The Hidden Treasure Mine is supposed to be on the same vein as the Ready Relief, and here the vein varies from a few inches to five feet or more in thickness, averaging probably about fourteen inches, while the quartz is said to have yielded an average of about $65 in free gold per ton.

GOLDEN CHARIOT MINE.

The old Golden Chariot Mine, some two or three miles southeast from Banner, and in the same belt of slates, is said to have yielded in the past an aggregate of between $600,000 and $700,000. But it has been idle for some years now. Various stories are current concerning the cause of its stoppage. One of them asserts that they "lost the vein," inasmuch as they met a "fault" through which they could not find their way. Other stories are not so creditable to the managers. It is said to be about thirteen years since they stopped work.

The belt of slates from Julian to Banner, and farther southeast, will average about one mile in width. Its width, however, varies at different points, and it is not straight, but curved, being convex towards the northeast. At Julian the general strike is north 70 degrees west, but at the Ready Relief Mine at Banner it is about north 50 degrees west magnetic. For a distance of some two or three miles along this belt there are four well defined veins, known respectively as the Chariot, the Ready Relief, the Cable, and the Ruby Veins. Of these, the first is the most northeasterly, and the distances between them are respectively nine hundred feet, six hundred feet, and four hundred and twenty-five feet. All four of these veins have been located continuously all the way from Julian to Banner.

At the Cincinnati Bell Mine there are two shafts—one eighty feet deep on the Cable Vein, and the other sixty feet deep on what is called the Knelly Vein. The first vein here ranges from a few inches to two feet or more in thickness, and the other one averages about eighteen inches. The Knelly Vein here has furnished some enormously rich specimen ores, but the amount of drifting that has been done is very small.

READY RELIEF MINE.

There is at the present time a very large amount of ore in sight in the Ready Relief Mine at Banner—estimated by the manager and part owner, Mr. D. D. Bailey, at twenty-five thousand tons. Mr. Bailey also states that the whole mass of this ore taken indiscriminately from the mine will yield an average of $12 50 per ton, free gold in the mill, while portions of it are of course far richer. He furthermore says that he once ran a lot of slate from the waste heap through the mill and got $6 per ton in free gold out of it. These slates contain many small bunches and threads of quartz. He therefore proposes at some future time to run pretty much all his waste heaps through the mill. The total yield of the mine up to the present time has been just about $450,000.

According to an estimate published in the Julian "Sentinel," of August 2, 1889, the total aggregate yield of all the mines of the district, including the Golden Chariot and the Stonewall, has been something over $5,000,000.

which certainly speaks remarkably well for this portion of San Diego County.

SAN FELIPE VALLEY.

On leaving Banner and going towards the San Felipe Valley, the road quickly passes out of the slates into a granite region, and from here no rock except granite was seen along the road as far as Warner's Ranch.

WARNER'S VALLEY HOT SPRINGS.

In the northern part of Warner's Valley there are some hot sulphur springs, and many other mineral springs are said to occur in various parts of the valley, some of which contain a good deal of iron.

PALOMAR MOUNTAIN.

West of Warner's Valley and north of the San Luis Rey River there rises a high mountain mass known as Palomar Mountain, which was ascended to the summit, and found to be, according to the aneroid barometer, about five thousand eight hundred feet above the sea. The culminating point is one or two miles westerly from the house of George V. Dyche, who has lived here since 1868, on Section 18, Township 10 south, Range 2 east, S. B. M., at a height of about four thousand seven hundred feet above the sea. Palomar Mountain is really a southern spur of the much more extensive range known as Smith's Mountain. It, however, lacks probably not more than two hundred or three hundred feet of being as high as the highest crest of the main range.

The country here, so far as seen, is all granitoid, though varying largely here, as elsewhere, in texture and composition. Feldspathic veins and bunches of quartz are not uncommon, the latter often containing tourmalines.

Asbestus, with fine fibers six inches long, is said to have been found in the mountains northeast of Warner's Valley, and within three miles of the hot sulphur springs. On leaving Warner's Valley at the northwest end, the road to Oak Grove (which, by the way, is a portion of the old stage road from Los Angeles to Fort Yuma) passes for some little distance over a narrow belt of coarse micaceous schists, which strike about north 45 degrees west magnetic, and stand nearly vertical.

TEMECULA CREEK.

Beyond here the country, so far as seen, for a considerable distance is entirely granitic. Indeed, nothing but granite was seen until just before reaching Radec, a little Post Office on Section 19, Township 8 south, Range 1 east, S. B. M. Here again was found a narrow belt of slates striking northwesterly and standing nearly vertical. Some prospecting has also evidently been done about here for gold, but we did not learn that anything of importance had been found.

Below Radec, there are for several miles along the valley of Temecula Creek heavy beds of granitic debris, in the form of sand and gravel, which are often nearly horizontal in their bedding. Where the granite shows in place along the road down this cañon much of it is thoroughly decomposed and soft, but in the higher portions of the adjacent hills most of it is hard enough. Passing on, we traverse the Paula Grant, where there is a broad valley containing many acres of rich, arable land that is still abused as a sheep pasture instead of being put to the far better uses of which it is capable.

Wolf's Ranch is on the Little Temecula Grant, three and one quarter miles from Temecula Station, on the railroad. The word Temecula is probably of Indian origin, but its signification was not learned. The word Temescal is said to mean, among the rapidly disappearing Indians of this part of the State, a hut built of brush and covered over with earth.

At Temecula Station there was lying (November 10, 1889) a considerable quantity of dressed street paving blocks of a moderately coarse-grained, light-gray granite, which is stained more or less yellowish in places by oxide of iron.

The rock seems to be hard and durable, and splits and dresses well. It has been used for paving-blocks in Los Angeles and San Diego, and for street curbing in both those cities, and also in San Francisco. The quarry from which it comes is situated in the foothills on the southwest edge of the valley, about half a mile southeasterly from the head of Temecula Cañon. And here it may be well to correct an error which occurs on page 174 of the seventh annual report, lines five to eight from bottom of page, where it is stated that Elsinore Lake, in times of heavy rains, "discharges its surplus waters into Temecula Cañon, a branch of Temescal Creek, which runs to the Santa Ana River." The writer was led into his mistake about the name of the creek by an erroneous map on which the upper part of Temescal Creek is labeled "Temecula Cañon."

As a matter of fact, the only discharge of Elsinore Lake (and this at rare intervals) is into Temescal Creek. And there is but one Temecula Creek, which, coming from the higher regions to the east, passes through the Paula Grant and enters the cañon, followed by the railroad a little below Temecula Station. But, as in other cases, so here; different parts of the same stream have different names. And for a number of miles southwesterly from its head, and through all the rougher mountains, this cañon, which the railroad follows, is known as Temecula Cañon. But lower down along its course, through the Rancho Santa Margarita y Las Flores, the same stream is called the Santa Margarita Creek.

TEMECULA CAÑON GRANITE.

In the Temecula Cañon itself there are now two quarries, one about two miles and the other about three miles below the railroad station. From the lower one of these quarries, a block was lying at Temecula Station on November tenth, which will dress into about a thirty-inch cube, of a dark gray and fine-grained syenite without a flaw. This block is to form the basis of a monument of some sort at San Diego. The rock contains a little magnetic iron. But it appears to be very hard and strong, and will probably take a beautiful polish and prove to be very durable.

SMITH'S MOUNTAIN.

Thomas Cook, of Temecula, whose father has for many years owned a ranch near the highest summit of Smith's Mountain, says that the mountain consists almost exclusively of granite, and that he has never observed any slates high up in the range, though there are some scattered here and there along its northeastern foot. He also says that no valuable minerals have ever yet been discovered, so far as he knows, anywhere in Smith's Mountain. There is, indeed, a tradition to the effect that a good many years ago, a soldier, straying about, found some very rich gold quartz somewhere in the range. But immediately after his discovery he was overtaken by one of those dense fogs which sometimes cover these mountains, and lost himself, and after wandering about for two or three days at last got out of the mountains and found his way to Warner's Ranch. But he was never able to again return to the spot where he found the gold. This tradition is only related here because it is such a perfect parallel to many other such traditions scattered up and down about the country, some of which, instead of involving a simple soldier, refer to old Mission fathers, whom also they forgot to name. It is hardly necessary to add that all such traditions as these, while not, perhaps, beyond the limits of possibility, are, nevertheless, wherever unsustained by reliable records, very far beyond any limits of probability, and should be treated like the idle wind which blows "it knows not where it listeth."

The highest point of Smith's Mountain is a rather sharp peak some two or three miles in an air line southwest of Oak Grove, and is not far from the line between Sections 13 and 14, Township 9 south, Range 1 east, S. B. M.

David Warren, of Temecula, who is well acquainted with the country, says there has been a good deal of prospecting done in the granite mountains northeasterly from Warner's Ranch, and a little gold found in many places, but nothing that would pay.

COAHUILLA OR KAWEAH.

In the neighborhood of Coahuilla Valley, probably on Township 7 south, Ranges 2 and 3 east, S. B. M., there is said to have been considerable quartz found which would run from $4 to $6 per ton, but no mining of any account has ever yet been done there.

And, by the way, this Coahuilla Valley ought not to be mixed up with two or three others of the same name scattered about the central and southern parts of the State. The name Coahuilla, though differently spelled, is beyond a doubt originally the same as Kaweah, and there is to-day no perceptible difference between the common pronunciation of the two in Southern California. It is an Indian word, and an attempt at the Spanish spelling of which is Coahuilla, while a corresponding attempt to find some English orthography for it is Kaweah. The word probably has a meaning, though the present writer does not know what it is. Anyhow, the name has become attached to several widely separated localities, mountains, valleys, and at least one large river in the southern portion of the State, and care should therefore be exercised in discriminating between them.

Within a radius of ten miles around the center of Township 10 south, Range 2 west, S. B. M., no mines of any value have ever yet been found, so far as I could learn. There was once an old branch Mission at Pala, on the San Luis Rey River, below the Pauma Grant.

ASBESTUS AND TALC.

Peter Mouren, proprietor of the hotel at Temecula, has samples of asbestus and talc, which he says came from a point about three miles from Winchester Station, on the railroad between Perris and San Jacinto, and probably from near the southeast corner of Township 5 south, Range 1 west, S. B. M.

Mr. Andrew Bladen, of Temecula, says that about seventeen miles northeast from Temecula, and some eight miles north from Radec, there is a belt of slates in which there is a quartz vein thirteen feet thick, on which he has sunk two shafts, one twenty-two and the other forty-seven feet deep, and of which the average of many assays gives $18 per ton, though none of it has yet been milled. He also says that it can be traced and has been located for a distance of four miles or more. It is on the northeast side of a slate belt close to the granite. It strikes northwesterly and dips very steeply, probably 80 degrees or so, to the southwest. There is plenty of wood and water close at hand.

GOOD HOPE MINE.

The Good Hope Mine is about six and a half miles northeasterly from Elsinore, and about five miles southwesterly from Perris. It is a vein of quartz striking about north and south magnetic and dipping 40 degrees to 50 degrees towards the west in the granite. Much of the granite here is more or less syenitic, though it is not all so. Much of it also is greatly decomposed and quite soft, though some of it is extremely hard. The old workings here are now all full of water, the mine having been idle for some years. The greatest depth reached in the old works is said to have been between two hundred and three hundred feet. The property has recently changed hands, and is now being reopened.

Two new slopes were being sunk on the vein, one of which was down about sixty feet when visited, and the other one hundred and sixty feet. No drifting had yet been done from either of these slopes. The vein is very irregular in thickness, sometimes splitting up into very thin stringers, or even running out altogether, and again opening out into lenticular bodies of considerable size, some of which are said to have been over eight feet in thickness. There is a five-stamp steam mill here, built by H. J. Booth & Co., of Marysville, in 1881. Some of the ore is extremely rich. Much of it also is more or less crystalline, and of a readily crumbling texture, so that it is very easily crushed. One or two miles northeast of Elsinore some rocks were seen which have the appearance of basaltic dikes, though the exposures here are very poor.

In the hills northeast of Elsinore there stretches for many miles in a northwest and southeast direction a rather broad belt of very highly metamorphosed rocks, some of which consist of very thin-bedded slates, while others are very heavy-bedded, and blocky in their structure, and very hard. Veins of quartz are occasionally found in these rocks, and they are also broken through here and there by irregular and extensive dikes of porphyry and basalt.

LIMESTONE.

At one locality within this belt, and on about the middle of the south half of Section 28, of Township 5 south, Range 4 west, S. B. M., there is a considerable body of hard, dark blue, compact limestone. Here, two small kilns have been built, and some of the limestone burned, producing, it is said, a very good quality of lime. A company is now being organized for the purpose of manufacturing hydraulic cement by mixing this lime in certain proportions with the clays that occur in such large quantities among the hills northwest of Elsinore.

TERRA COTTA.

At Terra Cotta, close by the coal mine of Messrs. Dolbeer & Hoff, a description of which was given in the seventh annual report, pages 175 and 176, some parties have expended about $22,000 in the erection of works for the manufacture of drain and sewer pipes.

These works were erected at this locality in the expectation of employing the clay from a bank close at hand in the making of pipes, and that the mine would furnish the coal for burning them, as well as for making steam under the boiler. Both expectations, however, were doomed to disappointment. The clay from this particular bank proved to be by no means suitable for pipes, and the coal mine has been abandoned, the bed proving at this locality of too poor a quality to pay to work. The coal, therefore, had to be obtained from the Chaney Mine, and the clay from another locality nearly two miles away. A large quantity of pipe was manufactured, however, and also some brick; but for some reason or other a very large stock of the pipe still remains on hand undisposed of, and the works are idle now. It is said, however, that preparations are being made for starting them up again soon.

CHANEY COAL MINE.

At the Chaney Coal Mine a small bunker has been erected, capable of holding from forty to fifty tons of coal, and the mine has latterly been producing at the rate of from five hundred to six hundred tons per month. Most of this coal is consumed for various purposes in the region round about—within six or eight miles of the mine—but some of it is shipped to various points along the railroad, even as far as San Diego.

In Temescal Cañon, near Mr. Stewart's house, and but a very short distance northerly from the Chaney Mine, there are very heavy dikes of porphyry and basalt, and not very far from the same locality some crystallized calcite has been found, which some people have mistaken for gypsum.

Among the granite hills around the San Jacinto River, for a number of miles easterly and northeasterly from Elsinore, more or less gold has been found in many places, and considerable shallow placer mining has been done here and there when water could be had.

CLAY BANK.

The bank which furnished the clay that was actually employed in the sewer pipe manufactory above described, is situated on the south half of the northwest quarter of Section 21, Township 5 south, Range 5 west, S. B. M.

This bank has been opened up so as to expose a nearly vertical face for a distance of some two hundred or three hundred feet, with a maximum height of about forty feet.

There are here a number of separate beds lying conformably one above the other and nearly horizontal, though really dipping very gently, perhaps 4 degrees or 5 degrees, towards the northeast. The face of the bank itself looks towards the northwest. The different beds vary largely in color and quality, and only certain ones are used. The lowest one exposed is from five to seven feet thick, of dark blue clay, containing but a small quantity of very fine sand.

Next above this comes a bed from four to five feet thick, of a light yellowish or buff-colored clay, which has been absurdly miscalled "asbestus" by the quarrymen, apparently for no cause except that it contains considerable quantities of very fine scales of talc nearly white in color. It bears no resemblance whatever to asbestus. Next above it comes a heavy bed, ranging from four to eight feet or more in thickness, the lower two thirds of which is mottled with rose, pink, buff, and white, while the upper portion is mostly of a dark red color.

The three beds above described are the only ones which have yet been used. The beds in the higher portions of the bank overlying these, so far as yet exposed, are mostly too gritty to be used as clay, though a few thin streaks of fine quality of clay occur. A thin streak in the upper edge of the lowest bed is almost black in color, and among the red clays small quantities of beautiful red ocher have been found. They are now hauling clay from this bank in wagons, a distance of some six or seven miles, to the railroad at Esinore Station, and shipping it thence to Los Angeles. Some white quartz sand is also being sent from Elsinore to Los Angeles. Besides the large sewer pipe factory above described at Terra Cotta, which, though idle now and unfortunately located, will probably be running again before long, a small establishment has been erected close by the Chaney Coal Mine for the manufacture of pottery, and some very good pottery has been made there; but the quantity so far is small.

HENDRICKS DISTRICT.

A locality called the Hendricks District was not visited, but is situated about the summit of a high peak in the northeastern front of the Santa Ana Range, which bears north 86 degrees west magnetic, distant some eight or ten miles in an air line from Elsinore, and probably two thousand five hundred feet or more above the level of the town. This district is said to have furnished some very complex ore containing lead, silver, copper, nickel, etc. But a single sample from there presented to the writer, and tested at the Bureau, contained no nickel, but only a little copper.

TABLE OF DISTANCES.

The following is a list of distances from place to place as recorded by the odometer:

San Diego to Otay Village	12.35 miles.
Otay Village to Camp No. 1, on Jamul Creek	14.30 miles.
Camp No. 1 to Camp No. 2, at Engineer's Springs	
Engineer's Springs to Cottonwood Creek	6.41 miles.
Cottonwood Creek to Potrero	5.06 miles.
Potrero to Campo	10.33 miles.
Campo to Buckman's, about	11.00 miles.
Buckman's to Emery's house in Pine Valley	5.78 miles.
Emery's to Noble Brothers' new two-stamp mill	4.10 miles.
Emery's to Farley's	2.56 miles.
Farley's to forks of road in Guatay Valley	1.71 miles.
Forks of road in Guatay Valley to Stonewall Mine	11.17 miles.
Stonewall Mine to Julian	9.89 miles.
Julian to schoolhouse at Banner	5.57 miles.
Schoolhouse at Banner to Fred. Grant's in San Felipe Valley	3.98 miles.
Fred. Grant's to Summit	8.17 miles.
Summit to Warner's store	3.68 miles.
Warner's store to foot of mountain where San Luis Rey River leaves the valley, and the road starts up Palomar Mountain towards Geo. V. Dyche's place	8.15 miles.
Foot of Palomar Mountain to Geo. V. Dyche's house	6.33 miles.
Foot of Palomar Mountain to Oak Grove	16.12 miles.
Oak Grove to Radec	9.50 miles.
Radec to Temecula	16.49 miles.
Temecula to Elsinore	17.08 miles.
Elsinore to Terra Cotta	4.36 miles.
Elsinore to Good Hope	6.55 miles.

LIST OF ALTITUDES.

Following is a list of altitudes above the sea as read directly from the face of a good aneroid barometer:

Camp No. 1, on Jamul Creek	500 feet.
Engineer's Springs	900 feet.
Cottonwood Creek Crossing	750 feet.
Potrero	2,100 feet.
Campo	2,500 feet.
Buckman's	3,350 feet.
Emery's house in Pine Valley	3,650 feet.
Camp and mill of Noble Brothers	4,150 feet.
Eureka Mine of Noble Brothers	4,950 feet.
Farley's	4,000 feet.
Forks of road in Guatay Valley	3,600 feet.
Stonewall Mine	4,750 feet.
Julian	4,250 feet.
Helvetia Mine	4,200 feet.
Cincinnati Bell Mine	3,600 feet.
Ready Relief Mine	3,000 feet.
Fred. Grant's, in San Felipe Valley	2,500 feet.
Summit between Fred. Grant's and Warner's store	3,700 feet.
Warner's store	3,050 feet.
George V. Dyche's house	4,650 feet.
Highest summit, Palomar Mountain	5,800 feet.
Foot of Palomar Mountain	2,700 feet.
Oak Grove	2,700 feet.
Radec	1,650 feet.
Temecula Hotel	1,050 feet.

IRON ORE

Mr. Benjamin Reinhardt, of Chino, has furnished the following description of a very large deposit of iron ore in the eastern part of San Diego County:

From Walter's Station, on the Southern Pacific Railroad, in the Colorado Desert, it is about fifty miles in a northeasterly direction to the mouth of Eagle Cañon, and from thence it is about six miles up the cañon to where a very heavy bed of iron ore crosses the cañon in an east and west direction. On the west side of the cañon it is exposed continuously for the whole length of one claim, *i. e.*, fifteen hundred feet, ranging from ten feet to more than twenty feet in thickness. Beyond this it also shows at intervals for a considerable distance further, and a second claim has been located here. The flat in the bottom of the cañon here is one half or three quarters of a mile wide, and beyond this, on the eastern side of the cañon, the vein is said to be exposed continuously for a distance of five or six miles towards the east, and to be also larger here than it is towards the west. An analysis of this ore by Mr. McCarthy, of Chino, yielded him 63.7 per cent of iron, with only one per cent of silica, and no sulphur nor phosphorus. He also found in it a trace of silver, and in various samples from one tenth to three fourths of an ounce of gold per ton. The gold can sometimes be seen in this ore by the naked eye, but whether it will prove to be rich enough on the average to make it valuable as an ore of gold remains to be determined.

SANTA CRUZ ISLAND.

By W. A. Goodyear, Geologist, Assistant in the Field.

Of the four islands, Anacapa, Santa Cruz, Santa Rosa, and San Miguel, which lie south of the Santa Barbara Channel, the largest one, viz.: Santa Cruz, was pretty thoroughly examined by the writer in May, 1889. Before proceeding, however, to give a description of this island it is no more than just to say that several statements concerning these islands, and concerning Santa Cruz in particular, on page 185, Vol. I, of the "Geology of California," published in 1865, are utterly erroneous, and are due, as the context partly shows, first to the fact that neither Professor Whitney nor any of his assistants had yet examined the islands, and secondly to the fact that some very ill-informed person who had been there had mistaken volcanic breccias and conglomerates for ordinary "sandstones." As a matter of fact, there is no "sandstone," properly so called, anywhere near Prisoners' Harbor, and much more than three fourths of the whole area of Santa Cruz Island consists of materials that are volcanic in origin. But also, the history of the island has been a very long one, and its detailed geology and stratigraphy are very complex.

According to a map of the island in the office of the company labeled "Section X of Official Surveys," on a scale of $\frac{1}{20000}$, or about three and one sixth inches to the mile, and copied by W. M. Johnson and Stehman Forney, sub-assistants of the United States Coast and Geodetic Survey, in 1875, the extreme length of the island from east to west, in an air line, is 23.474 miles, and its total area is 58,344.55 acres, or 91.163 square miles. The greatest breadth of the western portion of the island is about seven miles, and that of the eastern portion four miles; while the least breadth, at a point between Prisoners' Harbor and Chinese Harbor, is 1.78 miles.

On this map the island is divided by lines, one mile apart, into one hundred and twelve lots, of which forty-eight are fractional, and contain an aggregate of 17,384.55 acres; while sixty-four are complete, containing six hundred and forty acres each, or an aggregate of forty thousand nine hundred and sixty acres. The lines of the lots run north and south and east and west, true course, like the section lines of the United States land surveys, and their numbering begins at the northwest corner and runs first south across the island, then jumps back to the northern shore and runs thence south across the island again, and so on. The line between lots 71 and 72 runs east and west through the midst of the buildings at the Main or Middle Ranch in the central part of the island, and the corner between lots 71, 72, 76, and 77 is about one thousand two hundred and fifty feet east of the office.

Lot No. 6 contains portions of two lots on the north shore.
Lot No. 33 contains portions of two lots on the south shore.
Lot No. 40 contains portions of two lots on the south shore.
Lot No. 41 contains portions of three lots on the north shore.
Lot No. 54 contains portions of two lots on the south shore.
Lot No. 67 contains portions of two lots on the south shore.
Lot No. 74 contains portions of three lots on the north shore.

Lot No. 99 contains portions of two lots on the south shore.

Lot No. 112 contains portions of two lots at the east end.

The highest peak of the island, two thousand four hundred and seven feet above the sea, is known as the Picacho del Diablo, and is situated just about the center of the northern half of the western portion of the island. The largest stream, called the Cañada del Medio, heads a mile or so to the west of the Picacho del Diablo, and after going southerly for a short distance bends to the east, and follows the latter course for five or six miles through the central portion of the island to the Main or Middle Ranch (Rancho del Medio), where it turns to the north and enters the Cañada del Puerto, which it follows for about three miles, to its mouth at Prisoners' Harbor on the northern shore. The Middle Ranch itself is about two hundred feet above the sea. The island is generally very rough, and large portions of it are covered with the densest chaparral.

The Eastern Ranch is at Scorpion Harbor, which is marked on the charts as the East End Anchorage, and the Western Ranch is at the mouth of the Cañon de Cebada, which is misspelled Cervada on the chart. Some other Spanish names are misspelled on the chart. For instance:

Gannada should be Ganado;
Valdaze should be Valdez;
Posa Anchorage should be Pozo Anchorage;
Cochie Point should be Coche Point; and
Cochies Prietos should be Coches Prietos.

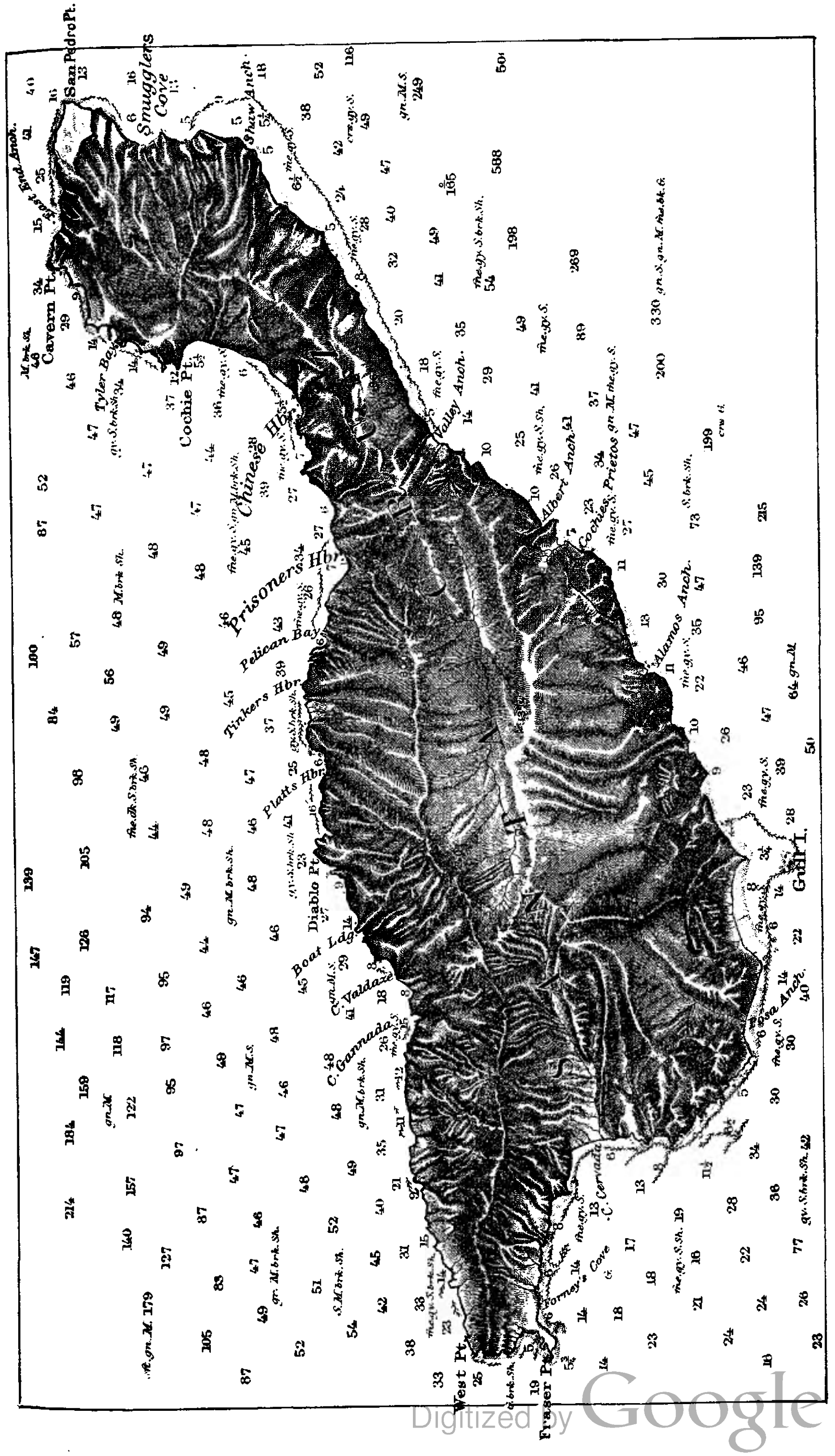
Three other localities along the shore are now known by different names from those by which they are designated on the chart:

Cavern Point is now called Palo Parado;
Tyler Bay is now called Potato Harbor; and
Valley Anchorage is now called El Puerto de la Cañada del Sur.

As the island was examined with a good deal of detail, and as its geology proves to be quite complex, it appears to the writer that about as intelligible a way as any in which he can give a description of it will be to first present the details in about the same order as that in which the observations were made in the field, giving successive dates of trips to various localities. In doing so it will, of course, follow that, as several localities were visited two or three times over, facts relating to one and the same locality will, in some instances, be found given in different parts of the report. But with a little attention (which would be necessary in any case) on the part of the reader, that fact need cause no confusion. This course will, therefore, be followed, and after that a few general conclusions may be drawn.

The accompanying map of Santa Cruz Island, will greatly assist the reader in understanding the details of this work. It is a photo-lithographic copy, without enlargement or reduction, from the United States Coast and Geodetic Survey Chart. Its scale is $\frac{1}{200000}$, or 3.156 miles to one inch. The soundings are given in fathoms, except within the dotted areas, where they are given in feet. The altitudes of a number of the higher points on the island above low water are also given in feet.

May 8, 1889.—Left Santa Barbara at 9:20 A. M., and anchored in Scorpion Harbor at the East Ranch at 12:20 P. M. Afterwards took the saddle and traveled fourteen or fifteen miles westerly over very rough hills, some of which are one thousand five hundred feet or more in height, to the Middle Ranch, which we reached about 7:30 P. M. For the first four or five miles of this distance, all the northeastern portion of the island seems to be made up of materials that are exclusively volcanic in origin, being breccias, conglomerates, masses of consolidated ash, etc. But the last two



thirds of the ground passed over by the trail seems to consist chiefly of a grayish white clay-rock, which breaks in angular blocks, though the exposures along the trail are few and poor. The wind was very heavy from the northwest all the afternoon.

May 10th.—The rock immediately south of the buildings at the Middle Ranch is a soft, decomposed, reddish-brown porphyry in place, containing small irregular stringers of quartz. Went to-day with Mr. Jules Moullet, Superintendent of the island, three miles northeasterly from the Middle Ranch, down the Cañada del Puerto to Prisoners' Harbor. The rocks, all the way down from the ranch to the harbor, are volcanic in origin, except some deposits of calcareous tufa, which furnish material for lime.

May 11th.—Went from the Middle Ranch to the Puerto de la Cañada del Sur. Everything seen in crossing the island was volcanic.

At El Puerto de la Cañada del Sur, the vertical cliffs are from one hundred to two hundred feet or more in height, and consist mainly of heavy masses of volcanic conglomerates, breccias, and tufas, which, however, in many places contain fragments of older shales, amongst which are here and there many bits of bituminous shale, showing that the volcanic eruptions are of more recent date than these shales.

Clots of pitch or asphaltum are also scattered around over the rocks on the beach here, having been washed up by the sea from the south. There is sometimes calcite among the cementing material of the conglomerates, and there are veinules of quartz running through them here and there, which are sometimes faulted. A deposit of calcareous tufa is very close to the Puerto de la Cañada del Sur. There are also considerable bunches of a very thinly laminated, hard and tough, impure quartz. The distance from the Middle Ranch to the Puerto de la Cañada del Sur is about three miles. Mocking birds are quite plenty on the island, and so also is a small species of fox, which they call the gray fox.

In the afternoon went out on the hills to the west of the ranch, and south of the Cañada del Medio. So far as seen to-day, they consist of a sort of clay-rock, which has been highly metamorphosed, and filled with irregular seams and veinules of quartz, and then afterwards much decomposed, leaving the surface of the hills thickly strewn with small angular fragments of quartz. I found in these shales one cube of oxide of iron resulting from the decomposition of pyrite. The highest point reached this afternoon is about one thousand four hundred feet above the sea. From here we came down to the Rancho del Portezuelo, and thence followed the course of the Cañada del Medio for several miles back to the Main Ranch. Everything seen to the north of the Cañada del Medio was volcanic, so that this cañada seems to follow about the line of demarkation between the volcanic country on the north, and the sedimentary metamorphic region on the south. Many of the decomposed shales south of the cañada are stained a deep red by oxide of iron, while in other places, where they are not so much decomposed, some of them are very hard and very siliceous.

The bulb of a small species of wild onion called "cacamite," which grows on the island, has a sweetish taste, with a very sticky feeling in the mouth.

May 12th.—Went a mile or so up the Cañada del Medio towards the west, then crossed over the ridge to the north, and came down to the shore not far from Tinker's Harbor, whence we traveled eastward over extremely rough mountain spurs and cañons to Prisoners' Harbor, and then back up the Cañada del Puerto to the Main Ranch. Everything yet seen to the north of the Cañada del Medio is volcanic, and mostly in the form of breccias and conglomerates, though among the Pinos Chicos, a little to the west of Prisoners' Harbor, there is a heavy massive eruption. The crest of the ridge where crossed to-day is about one thousand seven hundred feet high. On the northern slopes of the range here there is a good deal of *Lyonothamnus asplenifolius*, a peculiar tree, said to grow nowhere else except upon this island, and there known to everybody under the name of "ironwood."

May 13th.—Very nearly true north from the Ranch House there is a peak one thousand seven hundred and ninety-six feet high, on which there is a United States Coast and Geodetic Survey Station, and which is called Red Hill. The point where we crossed the summit of the ridge yesterday was a mile or more to the west of Red Hill, and the total distance traveled was probably about twelve miles. Just south of Prisoners' Harbor, near the road, on the west side of the cañada, there is a massive outcrop of hard, fine-grained, dark-colored basalt. But at the cape immediately east of Prisoners' Harbor, the rock is breccia, extremely coarse, and containing many bowlders of several tons in weight, most of which are coarsely porphyritic, though some of the smaller ones are black vesicular basalt. There are flakes of asphaltum or pitch scattered about here on the beach, and cast ashore by the sea. From Prisoners' Harbor, went this morning south, over the hill to the trail which comes from the Eastern Ranch, and found considerable of the whitish, slaty clay-rock which has been already mentioned. At a point about two thirds of the way across the island from Prisoners' Harbor to the Puerto de la Cañada del Sur, where samples were taken, it is a sort of clay-rock containing considerable extremely fine sand, and also containing certain small impressions, which may not improbably be remnants of some kind of fossil leaves, possibly of sea weeds, though they are too indistinct to be certain about them.

In the afternoon, went over to Coches Prietos Harbor. The red ridge to the south of the Main Ranch continues, going easterly, to consist of metamorphic sandstones and clay slates till within half a mile or so of Coches Prietos, where the volcanic breccias and conglomerates again set in.

At Coches Prietos Harbor, the mouth of which is not over two hundred yards wide, these rocks are stratified, and on the west side they dip about 20 degrees to the southeast, while on the east side they dip 40 degrees to 45 degrees in the same direction. But two hundred yards back from the mouth of the harbor, on the east side, the dip is again only about 30 degrees. The coarser material at Coches Prietos is mostly breccia, and its mass is very heavy; but it is overlaid, and here and there interstratified, with beds of finer materials, and sometimes with thin beds of fine sand. All these materials are volcanic in origin. The breccia sometimes contains streaks and bunches of chalcedony.

May 14th.—Went over to the Eastern Ranch, at Scorpion Harbor. On this trail going east, we first strike the white clay-rocks at about the point where the trail would intersect a straight line drawn southerly across the island from Prisoners' Harbor to the Puerto de la Cañada del Sur. These rocks then continue uninterruptedly for several miles along the trail to a point some distance southeast of Chinese Harbor, where we again strike the heavy masses of dark-colored volcanic rocks and breccias which make up all the highest peaks of the eastern portion of the island. The clay-rocks contain, in places, large quantities of flint.

May 15th.—The bluffs on the west side of Scorpion Harbor are a heavy solid mass of black vesicular basalt, much shattered and seamed. But a hundred yards further west, the cliffs, one hundred and fifty to two hundred feet high, are white. At the east side of the harbor there are in the cliffs heavy masses of hard white breccia, containing many fragments of black basalt, as well as of other rocks, the majority of which are white. This breccia is generally pretty highly siliceous, and contains large quantities of flint, chalcedony, etc.

Flakes of asphaltum are scattered over the beach. On the top of the bluff at the Palo Parado (formerly Cavern Point), some three hundred feet above the tide, is a United States Coast and Geodetic Survey Station. The top of the bluff immediately at this station is black basalt. But a short distance further east the basalt is overlaid by a nearly horizontal bed of light-colored sedimentary rock, which is filled with fragments of broken marine shells, and also contains masses of flint and fragments of basalt. This bed ranges from ten to thirty feet or more in thickness, and for some distance forms the top of the bluff, at a height of from two hundred and fifty to three hundred feet above the sea.

In the afternoon visited the extreme east end of the island, where the top of the bluff, which is one hundred feet or more in height, consists of what appears to be a consolidated rhyolitic ash, being white, fine-grained, and hard. But the lower parts of all these bluffs consist, so far as could be seen, of the dark-colored breccias. This point is marked on the chart as San Pedro Point. From here, Anacapa Island, as seen through a good field glass, presents every appearance of being made up of the same dark-colored breccias, etc., with no white rocks visible except towards its eastern end, where there are one or two small white streaks high up in the bluffs.

From San Pedro Point we went to Smuggler's Cove, where they were building a new house, as yet unfinished, and where there is a young plantation of fig and olive trees, and a vineyard. The rock with which the corners of the house are faced is the same clay-rock, containing small impressions suggesting fossil leaves, as that which occupies so large an area in the region south and southwest of Chinese Harbor. It is here obtained from a quarry some two hundred yards back, *i. e.*, to the west, from the edge of the surf in the cove, where it strikes north 50 degrees east magnetic, and dips about 20 degrees to the southeast. All the central parts of Smuggler's Cove consist chiefly of this clay-rock, but both the northeastern and southwestern promontories contain the dark-colored volcanic breccias. Some of the clay-rock itself is brecciated, containing older fragments of similar rock, together with a good deal of flint or chalcedony in streaks and bunches, but no volcanic fragments were found imbedded in the clay-rock. At one locality, in the southwestern part of the cove, a bed of hard, flinty clay-rock strikes about north 35 degrees east magnetic, and dips 15 degrees or 18 degrees to the southeast, and this rock is here immediately and conformably underlaid by *unmistakably bituminous* shale, which is quite soft.

May 16th.—There are isolated patches of white rock scattered here and there all over the northern part of the lower eastern portions of the island. On the west side of Palo Parado Bluff, and not more than two hundred or three hundred feet from the Survey Station, the white rock goes down in a sort of wedge-shape to the water's edge, the line of contact between it and the black basalt immediately north of it being almost vertical.

At Potato Harbor, alias Tyler Bay, the stratification of the white marine beds is nearly horizontal, and they are three hundred feet or more in thickness, as they extend down in places quite to the water's edge. They are, however, so far as can be seen, everywhere underlaid by the black basalt. At one point here, about three hundred feet above the tide, I found in the white rock a fossil clam shell.

Immediately west of Potato Harbor the hills rise much higher, and the white rocks disappear, the country from here to some little distance beyond

Coche Point being all basaltic. Much of this basalt seems to be massive, although the greater part of it continues to be fragmentary.

At one point in Chinese Harbor the stratified rocks, as seen from Coche Point, appear to dip, at a rather high angle, to the south; but half a mile further west, where they are well exposed in the bluff, they seem to lie nearly horizontal.

The wind has blown very heavily from the northwest for the last three days, inclusive, its velocity at times in the afternoon reaching probably fifty miles or more per hour.

May 17th.—We climbed to-day the highest peak of the eastern portion of the island, whose crest is about one thousand seven hundred and fifty feet above the sea. This peak is the culminating point of a high and rough basaltic ridge which forms, as it were, the "backbone" of all this part of the island. This ridge begins on the northern shore at Coche Point, and runs from thence almost entirely across the island in a direction about south 60 degrees east magnetic. The highest point is perhaps two thirds the way across the island, southeasterly from Coche Point. About three quarters of a mile northwesterly from the highest peak there is a United States Coast and Geodetic Station, whose altitude is one thousand five hundred and forty-nine feet. The rock at this station is a coarse-grained basalt, and all the higher parts of the ridge are basaltic, some of the rock being massive, though most of it is brecciated.

From the highest point, the stratified rocks in the southern part of the island immediately southwest from the ridge and southeast from Chinese Harbor, look as if their strike were approximately parallel to the course of the ridge and their dip southwesterly.

A mile or two southeast from this highest peak the main ridge breaks off and descends rather abruptly into some lower hills that skirt the southern coast. We lunched in a cañon at the Reparo del Aguaje, which expression does not seem to be good Spanish for the name of a locality, but which is used on the island to signify a place by a spring where the sheep are at certain times gathered together. It is among the lower hills at the southeastern foot of the high main ridge, and only about two hundred feet above the sea, and there is a spring of water there. At a point here about fifty feet above the bed of the cañon the white strata, consisting of thin layers of very fine sandstones and hard clay shales, strike about north 70 degrees west magnetic, and dip about 20 degrees northeast.

At a point in the ridge next west of here they strike about north 25 degrees west magnetic, and dip 25 degrees northeast. In the bottom of the cañon next west they strike about north magnetic, and dip about 18 degrees east.

The strata in the Cuchilla del Medio and other spurs running out towards the south from the south side of the basaltic masses are generally very thin-bedded, and to some extent curve around the basaltic mass like the coats of an onion. But they are also here and there irregularly curved and bent, and sometimes broken. There is much flint about here. For a considerable distance the Cañon de los Paredones Blancos runs about south 75 degrees east magnetic; and in the next ridge southwest of it, on the northeast side of which the rocks are well exposed for a long distance, they are everywhere extremely thin-bedded, and mostly clay-rocks, and their general strike is approximately parallel with the cañon, and their dip to the southwest at various angles from 15 degrees to 40 degrees. But here also, they are in places irregularly bent, and sometimes broken.

May 18th.—The line of demarkation between the high basaltic ridge and the white rocks to the southwest of it begins a little west of Coche Point, and thence follows a somewhat irregular course, whose general direction is not far from south 60 degrees east magnetic, across the island. From here westerly for several miles nearly all the narrow part of the island is white rock. The black basalt, however, shows again at the foot of a bluff just west of Chinese Harbor, and it probably underlies the white rock most of the way in depth.

A great deal of the white rock, even much of the hardest of it, which resembles flint in texture and hardness, emits a strong empyreumatic odor when struck with the hammer, suggesting a strong suspicion that it was once bituminous.

The highest point of the narrow portion of the island lies towards the southern shore, and is about one thousand four hundred and fifty feet above the sea. From it Chinese Harbor bears about north 5 degrees east magnetic, and Prisoners' Harbor north 50 degrees west magnetic. Everything here is the white clay-rock.

In the afternoon, visited once more the Puerto de la Cañada del Sur. Gray volcanic tufas form the bluffs for a certain distance along the central and eastern-central portions of the harbor. Next to them on the southwest, and forming all the hills and bluffs immediately southwest of the harbor, comes the black basaltic breccia in heavy masses. But east of the gray tufa, and forming all the eastern boundary of the harbor, come heavy masses of light yellowish rocks, which undoubtedly belong to the same class as the clay-rocks, which form most of the country for some miles to the east of this Puerto, so that at the Puerto itself the gray tufas occupy the space between the clay-rocks on the east and the volcanic breccias on the west. There is also some calcareous tufa at one or two points here. But while all around the central and eastern portions of the harbor the gray tufas and the clay-rocks form the mass of the cliffs, yet underlying them at near the water's edge, and stretching eastward to the furthest visible cape, the black basaltic breccias are exposed.

May 20th.—Early this morning a dense fog hung over the island. But by 6:30 A. M. this fog had disappeared from the neighborhood of the Middle Ranch, and the sky there was cloudless. Left the Middle Ranch at 6:30 A. M., and at 9 A. M. reached the summit of the Picacho del Diablo, the highest point on the whole island—two thousand four hundred and seven feet above the sea. All the upper part of the Picacho del Diablo, as well as the crests of all the ridges and spurs in this vicinity, consist of heavy masses of volcanic breccia. At 9 A. M., the fog has lifted from all the central portions of the island, but still hangs low and heavy over both the east and west ends. The whole Santa Barbara Channel, and the ocean also to the south and west as far as the eye can see, are one vast smooth level sea of fog, which I estimate to be nowhere more than five or six hundred feet deep, except where it rolls up against some of the flanks of the islands, where it rises in some places at the present moment to heights of one thousand or twelve hundred feet. On the summit of the Picacho del Diablo we are far above it all, and snow-white as the upper surface of the fog is in the sunlight, the sight is very beautiful. The Picacho de los Encinos, the second highest peak on the island—two thousand one hundred and forty-four feet above the sea—bears north 89 degrees west magnetic, about three and one half miles from here, and has every appearance of being made of the same volcanic breccias as the Picacho del Diablo.

None of the peculiar white clay-rock, which forms so much of the narrow part of the island, is visible anywhere from this peak in the western part, and everything north of the Cañada del Medio seems to be dark-colored basaltic rocks and breccias, which, however, in some places, have been much decomposed.

The "red belt" through the central portion of the western part of the island, and south of the Cañada del Medio, which is probably metamorphic, appears to begin at the west, between the Cañada de Cebada and its northern branch, called the Cañada de los Pinos, and to extend continuously eastward from thence through the island to within a short distance of the Puerto de la Cañada del Sur and the Coches Prietos, being nowhere probably more than one or two miles in width; while to the south of it a broad belt along almost the whole length of this part of the island, and extending quite to the southern shore, appears to be volcanic. This last volcanic belt includes the Sierra Blanca, the highest peak in the western part of the island south of the Cañada del Medio, and also the high chaparral-covered ridge a short distance west of Coches Prietos.

From the Picacho del Diablo we went down the northern slopes of the mountain towards the Cañada de Valdez, and ate lunch at an old Indian camp in the Cañon de las Tasajeras, some three hundred and twenty-five feet above the sea. In the cañon at this old camp, where there is water, one of the banks is a bed several feet in thickness of shells brought here by Indians. These shells are mostly mussels, but there are also a good many very large barnacle shells (some two inches in diameter), and some fish bones. Imbedded in this bank, and almost under the roots of a live-oak tree seventy-two inches in circumference now growing on top of it, I found a human skull, which, unfortunately, however, was too much decayed and too fragile to admit of transportation and preservation.

All the upper portion of the Cañada del Medio itself, down almost to the Rancho del Portezuelo, is in the volcanic rocks.

Mr. Jules Moullet, Superintendent of the island, says that there are a few small patches of "white rock" scattered here and there among the hills to the northwest of the Picacho del Diablo, though I saw none.

May 21st.—In the "red ridge" directly south of the Middle Ranch, the metamorphic rocks are not well exposed; but, so far as can be judged, they appear to strike northwesterly and dip southwesterly, at rather high angles.

The belt of volcanic rocks along the south shore between the Cañada del Sur and the Coches Prietos is perhaps one quarter of a mile wide. But immediately west of Coches Prietos it widens out rapidly, and the breccias in this ridge are generally distinctly stratified. In the hills eight hundred or nine hundred feet above the sea, and half a mile west of the Coches Prietos, they strike about north 50 degrees east magnetic, and dip about 35 degrees southeast. About half a mile still further west in a high bluff a dip of 50 degrees southeast was noticed. All these rocks are volcanic breccias and sands, generally dark colored. On the crest of a ridge some seven hundred and fifty feet above the sea I found imbedded in this breccia some fragments of quartz and also of *talcose slate*. Climbed to the crest of the highest and chaparral-covered ridge to the south of the "red ridge," and found it all volcanic breccia. Afterwards came down to the mouth of the Cañada de los Sauces. All the rocks here are volcanic breccia, and their general dip is to the southeast. They have, however, in places, been disturbed and faulted, and in one place I saw an irregular vein of limestone some six or eight inches thick running up through the face of the bluff for seventy-five feet or more. At one point on the beach here the breccias strike about south 80 degrees east magnetic, and dip some 40 degrees to the south.

May 22d.—At the summit of the trail to the West Ranch (Rancho del Oueste) the altitude is not far from one thousand three hundred feet. The rocks here are all volcanic. The next ridge south of here, which seems to be a continuation of the "red ridge," is covered with a dense pine forest all over its northern side, and the cañon next south of here, at the northern foot of the pine-clad ridge, is called the Cañada de los Pinos. It is a northern branch of the Cañada de Cebada, which it joins at a point perhaps three quarters of a mile above the Western Ranch House.

May 23d.—About three quarters of a mile south 33 degrees west from the Western Ranch House there is a United States Coast and Geodetic Survey Station, on the edge of a bluff some three hundred feet or so above the sea. The northern portion of this bluff consists chiefly of a heavy mass of conglomerate, in which the pebbles are rarely larger than a man's head, and are mainly volcanic. But a hundred feet further south there rises to the top of the bluff a heavy-bedded mass of medium-grained, light yellow quartz sandstone, the stratification of which could not be well made out from the top of the bluff. In some places this sandstone contains pebbles of quartz and metamorphic rocks mingled with others of volcanic origin, and also with fragments of older shales. At a point a little further south and a little lower down in the crest of the bluff, this sandstone is thin-bedded, and its stratification is well shown. It here strikes north 50 degrees west magnetic, and dips 38 degrees southwest. It also here contains occasionally large bowlders of older dark brown, or nearly black sandstone, which probably is or once was more or less bituminous. Further south and on the sea beach, the same sandstone is interstratified with beds of conglomerate, the pebbles of which are all small and well water-worn, and consist of volcanic rocks, with a small sprinkling here and there of quartz and metamorphic rocks. The strike here is north 26 degrees west magnetic, and the dip 35 degrees to the southwest. The bluffs here are all spattered with flakes of bitumen. On the top of this sandstone there is also a more recent, unconformable, and generally nearly horizontal deposit of volcanic gravel, which is again capped by the shell beds of the Indians mixed with the latest soil. Faults of moderate magnitude (*i. e.*, throws of two or three feet) are not uncommon in this sandstone. There is a very distinct odor of petroleum along this beach, and much of the bitumen plastered on the rocks has been landed there in a sufficiently semi-liquid condition so that it has run a foot or two in little streams down the rocks after being landed upon them. A quarter of a mile further south there is a considerable body of very thin-bedded and fragile clay shales, which strike north 15 degrees west magnetic, and dip about 50 degrees to the west. Some of these shales are pretty dark-colored, and it is not at all impossible that they may be slightly bituminous. The upper portion of the bluffs around the head of this cove consists generally of more recent horizontal beds of sand and gravel. Along the base of the bluff at the southern extremity of this cove there are very heavy masses of conglomerate, the pebbles of which are mostly metamorphic, and some of them granitoid, very few if any volcanic pebbles being mingled with them.

From the top of a high hill a mile or so back from the shore, I took the following bearings:

Western Ranch House (invisible), about north 30 degrees west magnetic.
Picacho de los Encinos, north 55 degrees east magnetic.
Center of Sierra Blanca, south 73 degrees east magnetic.
Biggest Gull Island, south 43 degrees east magnetic.
Pozo Harbor, south 13 degrees east magnetic.

This hill is about nine hundred feet above the sea, and though it is covered with soil on the top, it is unmistakably made up of unaltered sandstones, which also, as seen from here, seem to form all the hills along the coast to the south of here and also the hills to the eastward as far as the flanks of the Sierra Blanca (*i. e.*, for a mile or more to the eastward). These sandstones generally strike northwesterly and dip southwesterly at rather high angles. There is a United States Coast and Geodetic Survey Station right here on the top of this hill; but its altitude is not given on the chart. The next cañon south of the Cañada de Cebada is the one at the mouth of which is the cove where the preceding observations on the beach were made, and this cañon is also called the Cañada de los Sauces. It heads on the western flank of the Sierra Blanca. The recent horizontal strata in the bluffs near the mouth of the Cañada de Cebada often show a thickness of fifty feet or more of consolidated sands and gravels. The pebbles here are generally not very well rounded, and to the northwest from the mouth of the cañada most of them are volcanic, though there is also a considerable sprinkling of a variety of metamorphic rocks among them. I could find no fossils of any kind in these horizontal beds. The lower part of the bluff, which makes well out into the ocean a mile or so northwest from the mouth of the cañada, is a coarse volcanic breccia. Immediately south of the mouth of the cañada there is in the bluffs some selenite, which has weathered out in small fragments on the disintegrated slopes.

May 24th.—Went this morning to Pozo Harbor, so called because a well was once sunk to a considerable depth here in the coñon, without, however, finding any good water.

The bluffs immediately at Pozo Harbor are not very high. The lower twenty to thirty feet of them consist of unaltered sandstones and pebbly conglomerates, which strike north 40 degrees to 50 degrees west magnetic, and dip 30 degrees to 40 degrees southwest. Among the pebbles in these conglomerates there is some quartz, and a considerable variety of metamorphic, as well as some granitoid and volcanic rocks. These highly inclined strata are overlaid by from six to thirty or forty feet of recent horizontal beds.

From the United States Coast and Geodetic Survey Station, whose altitude is given on the chart as one thousand three hundred and twenty-nine feet, the highest point of the Sierra Blanca bears south 13 degrees east magnetic, distant perhaps half or three quarters of a mile.

The whole mass of the Sierra Blanca itself and all the white rocks immediately around it, as well as those at the United States Survey Station, are volcanic breccia. The line between these breccias and the unaltered sandstones and conglomerates to the west, passes half or three quarters of a mile west of the survey station and the summit of the Sierra Blanca, and runs, approximately, north 13 degrees west magnetic for several miles, while towards the south its course points almost exactly to the Gull Islands. It is slightly convex towards the west, and continues in about the same general northerly course as far as the Cañada de los Sauces, where it makes a sharp bend to the east and southeast (see below), and passing perhaps one third of a mile north of the United States Survey Station follows a course somewhat to the south of east for a mile or more (*i. e.*, as far as the Cañada de la Laguna), where it again bends somewhat towards the north, and then follows a general easterly course to the Cañada del Sur. Thus the "red ridge" south of the Cañada del Medio gradually widens out in going west, till at a point a little west of the Cañada de la Laguna, and about opposite the head of the Cañada de los Pinos, it is probably at least a mile and a half in width. Also, in the southern slopes of this portion of it, and about north from the Sierra Blanca, there is considerable granitoid rock in places, but greatly decomposed and soft, and intermixed here and there with strips of highly metamorphic rocks, and perhaps occasionally with volcanic dikes, although this last is doubtful.

Most of the breccias in and about the Sierra Blanca are stratified, and their general dip is southwesterly at rather high angles.

At and for some distance below the bend in the Cañada de los Sauces, the volcanic rocks, instead of stopping at this cañon as stated above, actually cross it and form the whole width of the ridge between it and the Cañada de Cebada for something like a mile to the west of the head of the latter. And for this distance, also, all the rocks visible in the northern slope of the ridge next south of the Cañada de los Sauces seem to be volcanic; while to the north of the Cañada de Cebada, and between it and the Cañada de los Pinos, the rocks as seen from here (*i. e.*, from a point on the crest of the ridge between the Cañada de Cebada and the Cañada de los Sauces, where the pine trees seem to be nearly coterminous towards the west with the volcanic rocks) do not appear to be volcanic, but seem to be a continuation of the "red ridge."

We followed along the crest of this ridge towards the west, and found out that volcanic breccia continues to form a large portion of it, at least as far west as the junction of the Cañada de los Pinos and the Cañada de Cebada.

The crest of the narrow spur immediately southeast of the Western Ranch House is a continuation of the northern part of this ridge, and the summit of this crest at a point, perhaps a quarter of a mile from the house, and about four hundred feet above the sea, consists of thin beds of unaltered sandstone alternating with much heavier beds of beautifully water-worn gravel, many of the pebbles of which are volcanic, the whole striking about north 20 degrees west magnetic and dipping about 35 degrees southwest, the course of the crest itself (which is here very narrow) being about north 75 degrees west magnetic.

May 25th.—Climbed the spur between the Cañada de los Pinos and the Cañada de Cebada. The western end of this spur, for a distance of something like a quarter of a mile from its point, is volcanic breccia. But next come the rocks of the "red ridge," which, where we first strike them, are largely granitoid in character. After following up this ridge for perhaps three quarters of a mile, went down its southern side into the Cañada de Cebaba, and then climbed it again by the cart road somewhat further east. The greatest part of this ridge consists of the "red ridge" rocks, and in this vicinity a great portion of it is syenitic. The "red ridge" rocks probably end towards the west at the point where we first struck them this morning. These rocks, where not granitic or syenitic, are always highly metamorphic, and I have nowhere seen any bowlders or fragments of volcanic rocks inclosed in them. We next descended the north side of the ridge, crossed the Cañada de los Pinos, and climbed the high ridge to the north of it, between the Picacho del Diablo and the Picacho de los Encinos, where everything is volcanic. The summit of the Picacho de los Encinos is a red porphyry. From there we traveled a mile or two further west along the main crest. Everything in this ridge so far, as well as in all the lower country to the north of it, down to the shore, is volcanic, and chiefly breccia. A great portion of the breccias in the higher parts of this ridge appear to be rudely bedded, with a rather high northeasterly dip.

The "horizontal beds," several times noticed above as capping the bluffs along the shores, are not exactly horizontal, but have a very gentle dip towards the sea, about the same in amount as the slopes of the present cañons. And these same beds can be traced far up some of the cañons, sometimes for several miles, and to heights of from six to eight hundred feet above the sea. Though they are often very thin-bedded, they seem to be of subaerial, and not submarine, origin, and they sometimes show evidence of the work of shifting streams.

May 26th.—Close by the Western Ranch House itself the bed of the creek runs over solid volcanic breccia, which contains some fragments of quartz and metamorphic slates, and whose general dip is westerly from 20 degrees to 40 degrees, but which has been more or less locally disturbed and sometimes faulted. There is also considerable quartz in places amongst the interstices of the breccia on the shore to the west of the ranch.

May 27th.—Between the Cañada de Cebada and the extreme end of Fraser's Point there is a strip of lower land sometimes half a mile or more in width, which has a general slope of some 5 degrees or 6 degrees from the foot of the higher mountains towards the south, and ends along the shore in an irregular line of precipitous bluffs, some of which are from two to three hundred feet high. Everything here is volcanic breccia. Hundreds of pelicans roost on the little white islet just off Fraser's Point, and there are a few sea-lions about there. So far as can be seen with the field glass from here, the rocky bluffs wherever exposed on Santa Rosa Island have also every appearance of being made up of similar volcanic materials.

On the top of the bluff, at the West End Point of the island, and somewhere near seven hundred feet above the sea, there is a United States Coast and Geodetic Survey Station, where the rock is a very coarse porphyry, containing crystals of feldspar half an inch or more in diameter. From the foot of the north side of the higher ridge, which forms the "backbone" of this part of the island, for one or two miles easterly from this station a gentle slope extends northerly to the tops of the bluffs, from three hundred to five hundred feet high, which go down almost vertically into the ocean. Everything here is volcanic. The coarse porphyry forms the crest of the ridge for a distance of something like one hundred yards easterly from the station, and then crops out on the southern slope of the ridge for some distance further east. Where it leaves the crest of the ridge it is overlaid first by twelve or fifteen feet of yellowish sandstone, which occasionally contains pebbles and angular fragments of it, the sandstone itself being then overlaid by moderately coarse-grained basaltic rock, the whole appearing to strike about north 20 degrees west magnetic and dip gently to the east. Later in the day the same coarse porphyritic rock was seen on the southern slope of the ridge, about half way from the West End Point to the Cañada de Cebada. For a short distance east from the West End, along the southern slope of the ridge, at an elevation of four hundred or five hundred feet above the sea, there is a line of bluffs which, from some points of view, might be taken for an ancient shore-line "terrace," but it is not one, and neither its base nor its summit ever formed a seashore, for all the mesa below it is breccia and there are no water-worn pebbles there. There are no "terraces" anywhere on the island, and no evidence of any recent rising or sinking; but the bluffs furnish plenty of evidence everywhere that the sea is and for a very long time has been encroaching on the island and wearing it away.

There are no craters, no accumulations of scoria, no lava streams, no columnar forms, no hot springs, no sulphur springs, nor any mineral springs of any kind on the island now. Nor is there any evidence of the existence of any mineral springs in the past, except of some calcareous ones, which have here and there produced a few deposits of tufa. Everything looks very ancient.

At a point about four miles from the Middle Ranch, on the trail leading to the Eastern Ranch, the white rocks strike about north 50 degrees west magnetic and dip some 35 degrees northeast; and here very fine-grained, somewhat argillaceous, and sometimes rather soft sandstones occur amongst the clay-rocks. The flint and chalcedony often contain vugs of drusy quartz.

On the left bank of the Cañada del Puerto, about one eighth of a mile northerly from the Middle Ranch House, there is a rather heavy body of moderately fine-grained sandstone inclosed in the volcanic breccias, and it is from here that the stone was taken which has been used in facing the corners of one or two of the buildings at that ranch.

Among the birds on the island, besides the mocking birds, there are crows, eagles, gulls, pelicans, larks, bluejays, and humming birds. Linnets are also very plenty in sheltered places. Amongst the insects, flies, both bluebottle and domestic, are very plenty, and are a nuisance. Also the fly which exactly resembles the ordinary house fly, except in its proboscis, with which it bites both men and cattle, is extremely numerous, and is a constant plague to animals. There are some nasty kind of flies, also very plentiful, along the sea beaches. Ladybugs were seen and gnats were encountered on the high peaks of the eastern part of the island. In some parts also there are occasional swarms of grasshoppers, which sometimes do some damage. But not a single mosquito was seen anywhere on the island.

From what precedes it will be evident that the detailed geology of this island is, as already stated, very complex. This examination is very far from being as full as it might have been made with further time and means at disposal, and yet it is full enough so that it will be impossible to understand it without an adequate map. But with the map, and after careful study, a few general conclusions may, with reasonable safety, be drawn:

First, the oldest rocks on the island are beyond question those of the "red ridge," which, lying south of the Cañada del Medio, and stretching westward from near the Cañada del Sur to a point between the Cañada de los Pinos and the Cañada de Cebada, consist chiefly of very highly metamorphosed slates and sandstones, with granitoid and syenitic rocks towards the western end. These rocks are similar in general character, and may belong to the same geologic age, as certain rocks in the mountain ranges on the continent to the north.

Next in order of age on this island probably come the white clay-rocks, which form so large a part of the narrowest portion of the island, as above described, and which contain impressions which suggest fossil leaves, and which very often give out a strong empyreumatic odor on being struck by the hammer, however hard they are. These rocks were probably laid down in deep sea waters long before any volcanic disturbance began. The arguments are these:

They were probably laid down in deep sea waters because they are generally extremely thin-bedded and very fine-grained. They are probably older than the volcanic rocks, first, because they do not inclose any volcanic fragments within them; and second, because they are universally upturned at high angles, and flank the volcanic rocks in various directions.

In fact, all this lot of white clay-rock probably belongs to the Coast Range series of bituminous shales, so largely developed on the continent opposite. In support of this may be repeated the fact that so much of this white clay-rock still emits so strong an empyreumatic odor when struck with the hammer, however hard it may be, and the further fact that a soft bed of unquestionably bituminous shale was found to immediately underlie a bed of this same hard clay-rock at Smuggler's Cove. For the deep sea origin of this rock there is also an argument in the absence of fossil shells; for most shell fish live in shallow depths.

I shall presume, therefore, that this clay-rock was deposited in a deep sea long before the volcanic disturbance began. But that disturbance came at last. Yet its action also extended over a very long time, and most if not all of the volcanic eruptions, properly so called, took place beneath the sea long before the island was lifted above its waves. Otherwise it would be impossible to account for the vast accumulations of stratified breccias, conglomerates, and volcanic sands without craters or scoriæ.

After the actual volcanic eruptions had nearly or quite ceased, but while the whole, or at least the greater part, of the island was still beneath the sea, came the formation of the white and more or less calcareous rocks containing sea shells, patches of which still remain at the Palo Parado and Potato Harbor, and perhaps also at other points in the eastern part of the island. Contemporaneous with these may have been the accumulations of unaltered sandstones and conglomerates containing volcanic pebbles and bowlders, which cover a good many square miles in the southwestern corner of the island, and which are generally upturned at high angles. After this came the final upheaval, which has lifted the island to its present height above the sea, upturning, bending, and crushing, to a greater or less extent, in different places, all the stratified rocks about it. But this upheaval itself was probably a slow and gradual process, occupying a very long period of time.

Then came the slow subaerial denudation and degradation which gradually formed the nearly horizontal beds which cap the bluffs and extend to considerable distances inland up the cañons in certain portions of the islands, as described above.

Last of all came the most recent period of more active erosion which has shaped the cañons as they now are, and has worn, and is still rapidly wearing away the bluffs along the shore.

As to the question whether these islands were ever connected with the continent by dry land which has since been washed away or sunk beneath the sea, every indication points most decidedly to the conclusion that they were never so connected.

First, the essentially volcanic character of the islands is entirely different from anything known to exist on the continent within a great many miles of the coast in this part of the State. Far more than three fourths of the whole area of Santa Cruz Island consists of volcanic materials.

Again, the breadth and depth of Santa Barbara Channel point strongly in the same direction. No point of Santa Cruz Island is less than twenty miles distant from the main shore. And the crooked line of deepest soundings through the channel, which is shallowest north of Anacapa Island, nowhere shows a depth of less than one hundred and seventeen fathoms. North of Santa Cruz Island the minimum of deepest soundings is one hundred and thirty-five fathoms. North of Santa Rosa it is three hundred fathoms, and north of San Miguel it is two hundred and twenty-five fathoms. But south of the islands the bottom slopes off rapidly into the ocean depths, and soundings of five hundred fathoms are found within a few miles from the shores.

It thus appears that these islands extend along the course of an ancient volcanic rift bordering the continent. At what period the disturbance which caused their uplift first began it is difficult to say, except that it seems certain that it was subsequent to the era of the accumulation of the bituminous shales. And at what time the volcanic action ended it is also impossible to say, except that it was certainly many long ages ago.

Wherever altitudes above the sea are given in exact figures in the foregoing notes, they are taken from the United States Coast and Geodetic Survey chart. But wherever they are only approximately given, and wherever the word "about" is used in connection with them, they are simply observations with a good aneroid barometer, which, wherever tested, as was often done at the various United States Coast and Geodetic Survey Stations, was found to agree generally within less than fifty feet with them.

It is not out of place here to say that my kindest acknowledgments and thanks are due to Mr. Justinian Caire, proprietor, and Mr. Jules Moullet, Superintendent of the island, for having freely placed at my disposal every possible means that could assist me in my work.

Since writing the article concerning Santa Cruz Island, I have read with great interest sundry articles in the Proceedings of the California Academy of Sciences concerning the Channel Islands.

Most prominent among these articles are two: First, an article by Prof. E. L. Greene in the Bulletin, Cal. Acad. of Sci., Vol. II, No. 7, June, 1887, page 377; and, second, an article by Prof. Joseph Le Conte in Bulletin, Cal. Acad. of Sci., Vol. II, No. 8, page 515, in which Professor Le Conte reviews Professor Greene's article.

And, in view of all these articles, I will venture to reiterate emphatically my own opinion that there is not, as yet, one particle of evidence tending to show that these islands were ever connected, dry-shod, with the mainland. It is probably true enough that they are situated along the southwestern edge of what might be called the continental plateau, and that just southwest of them the bottom slopes steeply down into the great depths of the Pacific Ocean. But what right has anybody to theorize from that fact alone as to their previous connection with any continents on one side or the other?

Professor Greene suggests, on page 388, that "our little archipelago may actually have been connected with some other continent than ours."

Professor Le Conte maintains, on the contrary, that the islands were once joined to the mainland, and amongst his proofs refers to Proceedings of California Academy of Sciences, Volume V, page 152, as showing that "remains of the mammoth have been found on Santa Rosa."

On reference to Volume V, page 152, I find this paragraph: "Mr. Stearns called attention to the fossil tooth of a species of elephant from Santa Rosa Island presented some time ago by Mr. W. G. Blunt, as it proved that the island was formerly a portion of the mainland. He had been informed by Mr. Blunt that the tooth had been found *in situ*, and near it was embedded the tusk of an elephant, the latter so far decomposed that it crumbled in the attempt to get it out."

This was in 1873. Now, I know Mr. Stearns well, and know him to be an able and upright man, but I also know that he was liable to be sometimes mistaken, especially where he got his information at second hand, as is confessedly the fact in this instance.

I very much doubt the *fact* whether any "elephant" or "mammoth" bones were ever found on Santa Rosa Island. I think it far more likely that they may have been fragments of the bones of a whale or some other marine animal. But, even granting it were true that bones of the mammoth had been found there! What does that prove, or what does it amount to, in the face of a hundred other conflicting facts which point another way?

The very fact of the vast difference between the flora of these islands and the flora of the mainland, is a strong argument against the supposition that they were ever "connected" with it.

It seems to be necessary every now and then to remind even the most famous geologists of the stale fact that "*geologic time is long*."

Now, if these islands were uplifted during the miocene epoch (which seems not improbable), time enough has elapsed since then to allow for all the differentiation and modification, or even *evolution* of species of both plants and animals that has occurred.

There is not one particle of evidence to show that they were ever "connected with the mainland."

STRAY NOTES ON THE GEOLOGY OF THE CHANNEL ISLANDS.

By Dr. Lorenzo G. Yates, F.G.S.A.

During a recent cruise among the islands forming the southern boundary of the Santa Barbara Channel, the writer noted some facts and generalizations on the geology of the islands which, supplementing other notes made during a visit to Santa Rosa Island some twelve years ago, are herewith given as being of interest, not only from their peculiarities in a geological point of view, but, also, as presenting some grand and picturesque scenery, in a locality which, although but a short distance from some of our well known resorts, and almost in the immediate track of the great bulk of the travel on the coast of Southern California, is still a locality about which little is known.

Thousands of our people have lived all their lives within fifty miles of these islands, passed within a few miles of their picturesque, cavernous shores, and know comparatively nothing of them, but the time is not far distant when they will be considered as among the most attractive objects of interest on the Pacific Coast.

From their peculiar position relative to the adjacent shores of the mainland, they act as an immense natural seawall, which not only protects the coast from the southerly storms of winter, but also affords a safe channel on their north side for a distance of about one hundred miles from Point Concepcion eastward.

This chain of islands, composed of San Miguel, Santa Rosa, Santa Cruz, and the Anacapas, are of volcanic origin, and seem entirely separate and distinct from the formation on the mainland, except that a similar volcanic formation seems to extend for some distance on the mainland south of the Santa Clara Valley.

The base and formation of the islands, at and below low water mark, seem to be composed entirely of hard, black amygdaloidal basalt, containing chrysolite and chalcedony in the cavities. This formation extends to about twenty feet above high water mark, although this height is not uniform.

The rock of the later formation overlying this base is composed of basalt and other rocks in various stages of decomposition, and in many places contorted or broken up by upheavals and intrusions.

This peculiarity is especially apparent on the islands of Santa Cruz and the Anacapas, where in many places vast quantities of breccia occur.

The harder fragments in these breccias gradually weather out, and falling, form the debris of the shore, and also that at the bases of the steep and perpendicular cliffs, which are common to the shores and the interior of the islands.

The Anacapas consist of three separate islands (see map, Figure 1), although the passages are so narrow between them that, unless closely examined, they would be supposed to be connected. They, at a comparatively recent time, doubtless formed one continuous mass of basalt, but in consequence of the presence of veins of softer rock, which are seen at short intervals crossing or cutting the horizontal layers of basalt, caves are formed by the combined action of the waves, the wind, and the rain, which in time cut entirely through the deposit and formed channels between the different portions. This characteristic is shown in Figure 2, where the ocean has encroached on the land from both sides, leaving a narrow strip, only a few rods in width, through which the wind and waves have formed a beautiful arched passage, by which one may pass on foot from the channel to the ocean side of the larger or Western Anacapa.

At this point the basaltic rock takes on various forms, as we find a beautiful amygdaloidal basalt, the cavities of which are lined with drusy crystals of chrysolite; vesicular trachyte, some of which is decomposing and contains iron pyrites, the surface having a yellowish powdery appearance. These formations are very pretty under a magnifying glass.

The basaltic rocks at this locality are more interesting than at any other point visited, some of it being coarse grained and dotted with amygdaloidal pebbles of milky white chrysolite, or translucent opal-like chalcedony; others with small and closely set, round, white "shots" of chrysolite or chalcedony, and on the channel side near the archway we found a distinct ledge or vein of pale, pink chalcedonic quartz, which we traced for some distance.

On the top of the archway there seems to be a light deposit of drift, or possibly sea-worn pebbles, carried there by heavy storms before the passage was cut through; or, possibly, the entire island may have been uplifted, and this old sea beach is now perched upon the top of this passage way.

At a short distance eastward there is a channel of about sixteen feet in width, which divides the western from the middle island.

Figure 3 shows the channel between the middle and eastern islands, which can be crossed on foot at extreme low tide.

In Figure 4 we have an illustration of two stages of the effects of the destructive agency of the elements. In the arch on the right we see the opening made by the action of the waves; the upright column between the arched rock and the eastern extremity of the island, shown on the left of the sketch, illustrates a more advanced stage, in which the arch has fallen in, leaving only the upright portions.

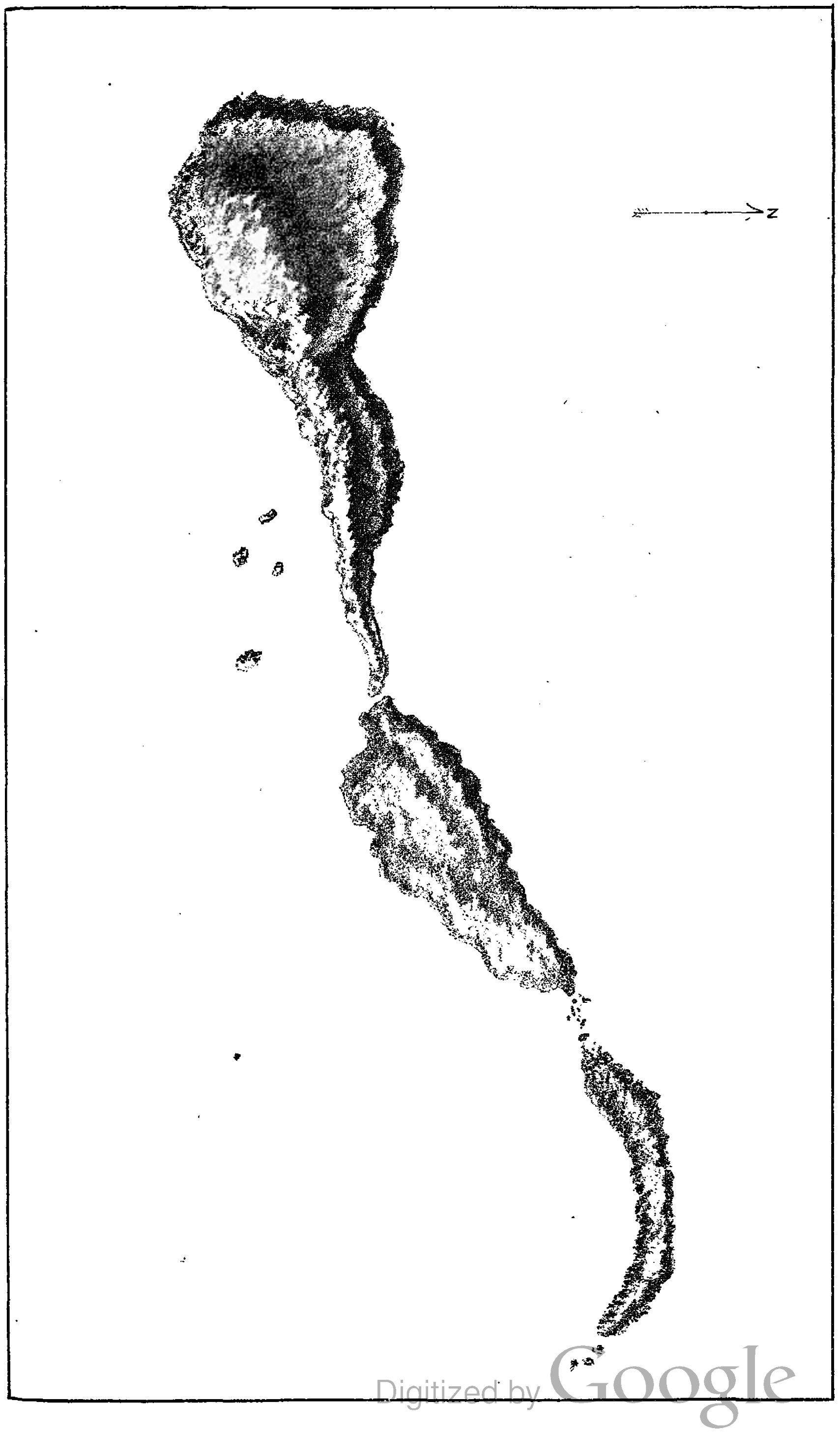
These openings are consequent upon the presence of vertical seams, crossing the islands at irregular intervals. These seams or fissures, probably caused by contraction or upheaval, subject the sides to the action of the exterior elements to a great depth, eventually forming veins of wacke or softened basalt. The beating of the waves and action of the tides on these veins of decomposed rock at the base of the cliffs form caves, which, by confining the incoming waves, are still more rapidly disintegrated than is the rock, which is not so exposed or acted upon.

This action of the waves, supplemented by the action of wind and rain at and below the surface, results eventually in forming chasms, extending from the cave at the base to the upper surface, and entirely across the islands in the narrower places; and, as the islands are continually being encroached upon from both sides, these divisions will increase more rapidly as the islands become narrower, and will become reefs of numerous isolated rocks.

The material of which these islands are composed must have been formed originally by a series of volcanic outbursts.

The only sandstone on the Anacapas is on the Western Island, where it is probable that the high peak, illustrated in Figure 4, may be sandstone. As none of our party climbed to this point, I cannot state positively that it is not sandstone; but that it is, is probable from the fact that on the Island of Santa Rosa, on which I reported in 1876 (and which report, from

MAP OF THE ANACAPAS



my notes, was published in the Smithsonian report for that year), it will be seen that an extensive sandstone formation overlies the volcanic deposit on Santa Rosa.

In the sandstone of Santa Rosa Island I found several species of fossil shells of a late tertiary age, including *Hinnites giganteus*, *Turritella inezi-ana*, *Neverita callosa*, *Pecten pabloensis*, *Liropecten estrellanus*, *Venus Kennerlyi*, and a shell which Dr. J. G. Cooper determined as *Turbinella coestus*.

The report of the United States Coast Survey for 1862 also states that "the main peak of the Anacapas is marked on the north side by several deep gulches, with almost vertical sides running from the summit to the bluff. The whole formation is filled with innumerable cavities, giving it the appearance of an enormous blackened honeycomb." It is also stated that "not a drop of water is to be found on the island." Later researches have, however, demonstrated that good water exists there. One spring trickles from the rocks at the mouth of one of the large number of caves which occur at various places in the cliffs along the shore.

This fresh-water cave has furnished shelter to many generations of aborigines, as is evidenced by the extensive deposit of refuse on the floor, among which are found a large number of bones of various species of fish and cetaceans, mixed with marine shells and other refuse of an Indian rancheria. We learned of another "Indian cave" at the eastern extremity of the Middle Island, but did not visit it.

How many centuries have been required to bring about these great changes is unknown. The ancient lavas remain, to impress upon the mind of the thoughtful observer some idea of the æons of time which must have elapsed since the great changes in the conformation of the earth's surface took place, which have brought about the comparatively simple and unimportant changes which are indicated by the position and formation of these islands.

At one point only on the Middle and Eastern Anacapas did we find any rocks not of volcanic origin. On the table land of Middle Island, on the southern side, we found drift composed of fragments of talcose schist containing garnets, mottled jasper of various colors—red, brown, black, yellow, and green—large pebbles of chalcedony, and near this point a small ledge of impure limestone, with quartz and siliceous pebbles.

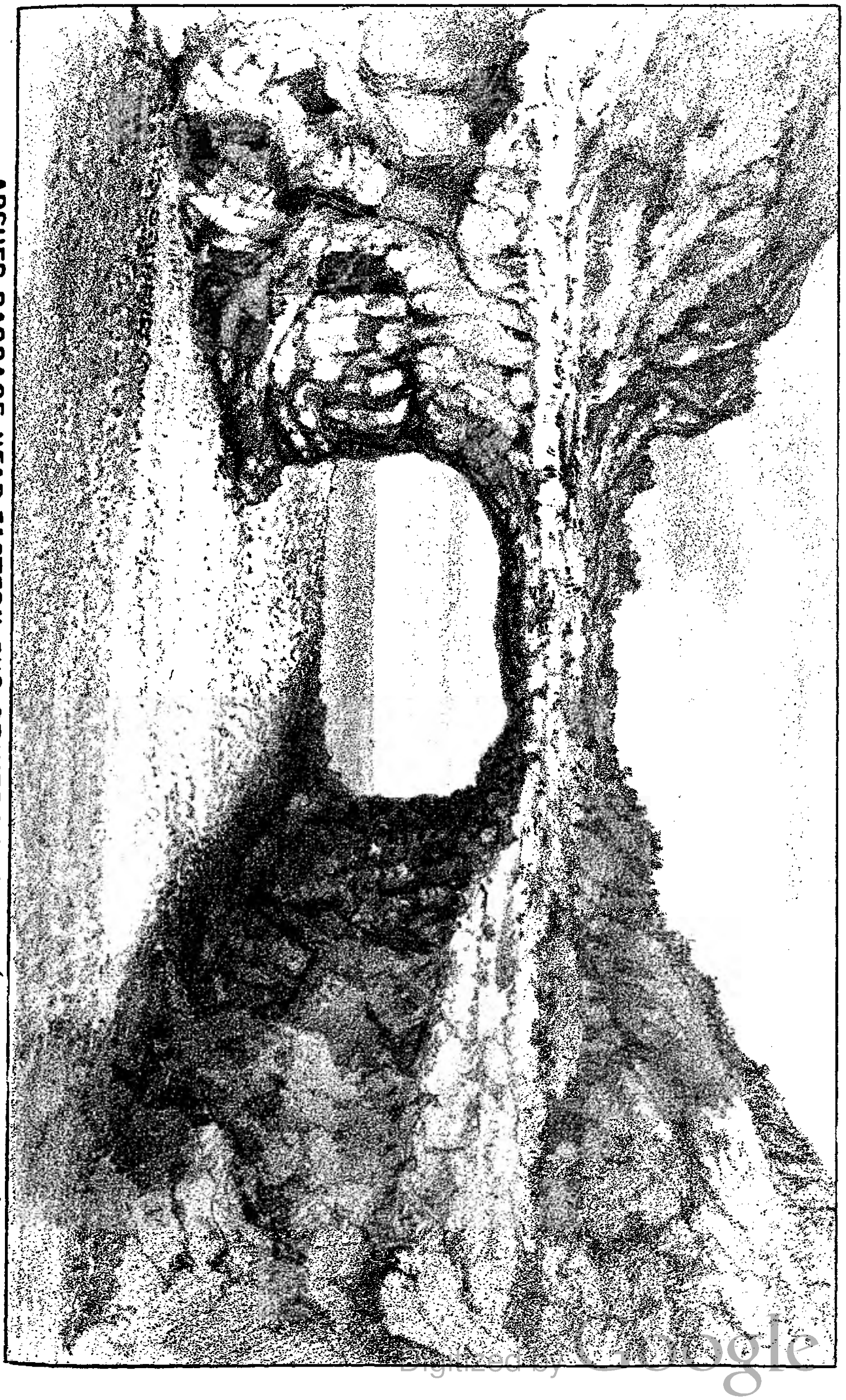
The oldest name for the Anacapas of which we have record is that of Innecapah in Vancouver's narrative, and Enecapah of his chart.

Santa Cruz Island is also put down in the Coast Survey Report as being "composed of coarse, dark gray sandstone, crumbling and rotten, like that of Anacapa." But how a party of scientific men, such as must necessarily be included in a Government coast survey, could report these islands as composed of "dark gray sandstone," when it is almost impossible to land upon the Anacapas without climbing over and among the coarse, black masses of basalt, which no one could for a moment imagine to be dark gray sandstone, is a puzzle.

One very interesting cave is located near Lady Harbor, on Santa Cruz Island, and is weathered out of the hard, rough, black basalt, presenting three entrances or arched openings, into one of which we rowed our boat, landing upon the smooth sandy beach of the sheltered interior, from which point we could pass through the other opening either way along the shore on foot. This cave is quite extensive, and is, perhaps, thirty to forty feet high. We visited a number of these caves, and sailed along close to the shore of all the Anacapas and Santa Cruz, passing miles of perpendicular basaltic cliffs, weathered out into all manner of forms; and the depth of water close to these cliffs is such that in the main a vessel can pass along within a stone's throw of the bluffs. So closely did we sail that we could distinguish the small plants clinging to the bluffs, some of them having the appearance of rosettes closely set over the face of the rock.

NOTE.—The map, Figure 1, is not made from any survey or scale, but was made while standing upon an elevated portion on Middle Island, and merely gives the idea as I comprehended it from that point; and in consequence of the interruptions of all communication with the outside world, resulting from washed out railroads, and the partial destruction of telegraph lines, the writer had less than a week in which to prepare the articles and illustrations.

FIG. 2.



ARCHED PASSAGE NEAR EASTERN END OF WEST ANACAPA (LOOKING NORTH)

THE MOLLUSCA OF THE CHANNEL ISLANDS OF CALIFORNIA.

By Dr. Lorenzo G. Yates, F.L.S.

The so called Channel Islands of California form the southern edge of the Santa Barbara Channel, and represent a peculiar province, in which may be found a greater variety of mollusca than in almost any other region of equal area.

Commencing at the island of San Miguel, off Point Concepcion, we have a coast exposed to the full force of the summer trade winds, which keep that portion of the province under the almost continuous action of the heavy swell from the northwest. This force gradually diminishes as we pass the islands of Santa Rosa and Santa Cruz, until on arriving at the Anacapas, the most easterly of the group, the force of the trade winds is so diminished as to be scarcely noticed. Then, again, the ocean side of these islands is exposed to the full force of the southerly storms of our winter season, while the channel side is protected from all these vicissitudes, and consequently affords convenient and safe habitation to those mollusca which delight in still water.

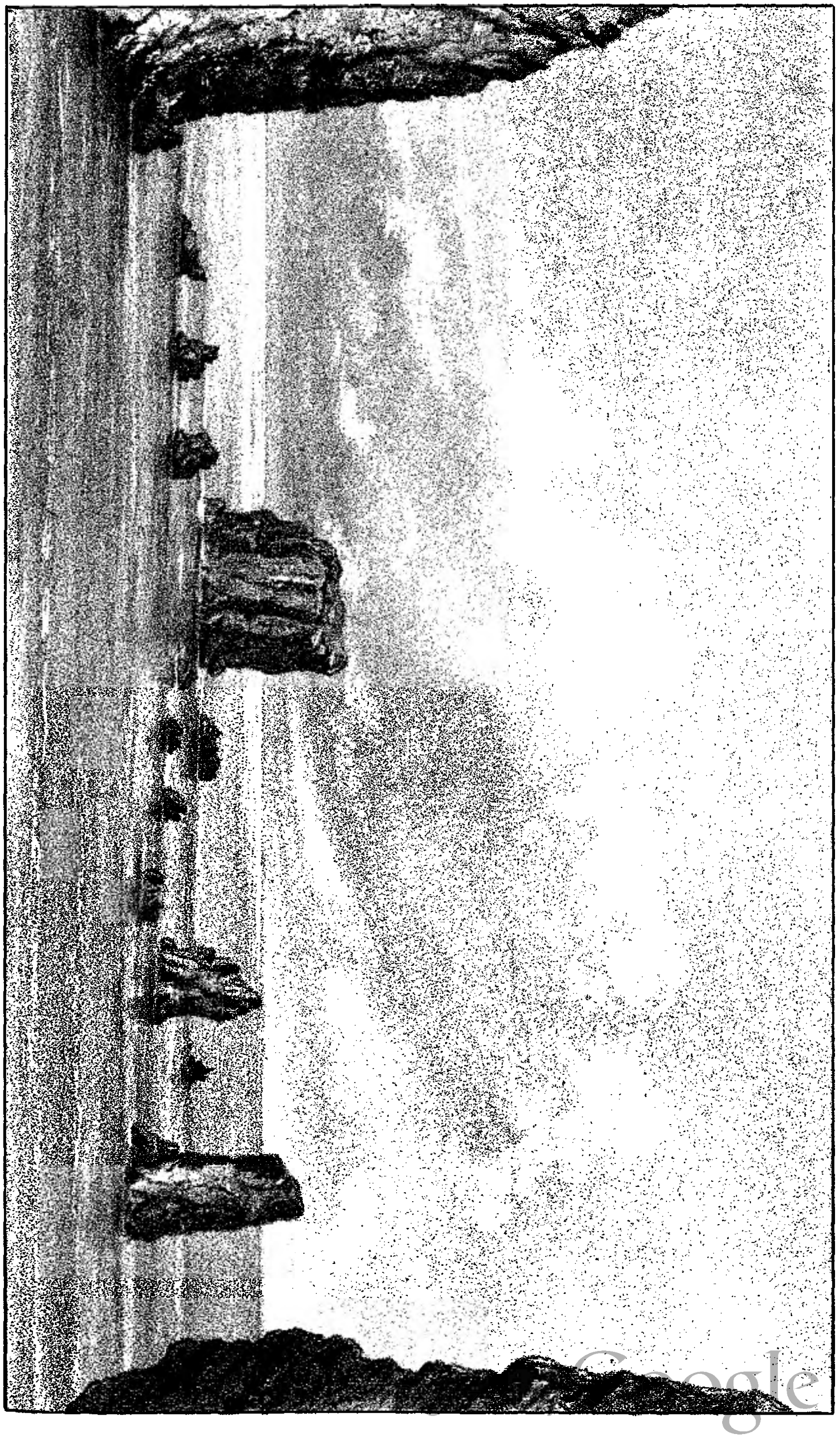
The character of the shore line at different points varies greatly, thus presenting all the varied requisites for the different requirements of the mollusca found on our coast; hence, these islands form a neutral ground, upon which the mollusca of the northern and southern faunas meet, and, as it were, overlap. They are the northern limit of *Luponia spadicea* and many other species, and the southern limit of many other genera and species.

The following list includes the species collected by the writer around the shores of Santa Rosa, Santa Cruz, the West, Middle, and East Anacapas. One species only (*Argonauta argo*) I did not find myself, as it is only at certain times that they are found. The various islands are referred to as follows: R. for Santa Rosa, C. for Santa Cruz, and A. for Anacapas. The list also indicates the species used by the aborigines of the islands, who formerly inhabited them. Those used by the former inhabitants as food are marked †; the species marked * were used for ornaments or money; those marked ‡ were used for paint cups and also as food.

Pholadidea penita, Conr.—R.
Pholadidea ovoidea, Gld.—R., C.
Parapholas californica, Conr.—R.
Saxicava pholadis, L.—R., C.
Glycimeris generosa, Gld.—R.
Cryptomya californica, Conr.—R.
Schizothærus nuttalli, Conr.—R.
Thracia curta, Conr.—R.
Entodesma saxicola, Baird—R.
Mytilimeria nuttalli, Conr.—R.
Solen sicarius, Gld.—R.
Macoma yoldiformis, Cpr.—R.
Macoma nasuta, Conr.—R.
Macoma inquinata, Desh.—R.
Tellina bodegensis, Hds.—R.
Tellina bimaculata, Linn.—A.
Lutricola alta, Conr.—R.
Cumingia californica, Conr.—R., A.

Standella planulata, Conr.—R.
*Tivela crassatelloides, Conr.—R.
Psephis tantilla, Gld.—R.
† Venus simillima, Sby.—R.
† Venus succincta, Val.—R.
† Tapes staminea, Conr.—R.
Tapes staminea, var. orbella, Cpr.—R.
*Saxidomus gracilis, Gld.—R.
Saxidomus nuttalli, Conr.—R.
Rupellaria lamilifera, Conr.—R.
† Petricola carditoides, Conr.—R.
† Chama exogyra, Conr.—R., A.
Chama pellucida, Sby.—R., A.
Chama spinosa, Sby.—R., A.
Cardium corbis, Mart.—R.
† Cardium quadragenarium, Conr.—R.
Cardium blandum, Gld.—R.
* Liocardium elatum, Sby.—R.
Cardita subquadrata, Cpr.—R., A.
Lucina californica, Conr.—R., A.
Diplodonta orbella, Gld.—R.
Diplodonta orbella, var.—R.
Kellia laperousii, Desh.—R.
Kellia suborbicularis, Mont.—R.
† Mytilus californianus, Conr.—R., A., C.
Mytilus edulis, Linn.—R., A.
Mytilus bifurcatus, Stearns—R., A.
Modiola modiolus, Linn.—R., A.
Adula falcata, Gld.—R.
† Septifer bifurcatus, Rve.—R.
Lithophagus plumula, Hanl.—R., C., A.
Axinæa intermedia, Brod.—R.
Axinæa septentrionalis, Midd.—R.
Pecten hastatus, Sby.—R.
Pecten hastatus, var. hindsii, Cpr.—R.
‡ Pecten aequisulcatus, Cpr.—R., A.
Pecten latiauritus, Conr.—R.
* Hinnites giganteus, Gray—R., A.
† Ostraæ lurida, Cpr.—R.
Succinea rusticana, Gld.—R.
Helix aryesiana, Newc.—R., C., A. (This species not heretofore reported from Anacapas.)
Physa D'Orbigniana, Lea—R.
* Dentalium indianorum, Cpr.—R.
Chiton (Mopalia) muscosa, Gld.—R., A.
Chiton (Ischnochiton) scabra, Rve.—R., A.
†Chiton (Ischnochiton) magdalensis, Hds.—R.
Chitor (Ischnochiton) cooperi, Cpr.?—R., A.
Nacella (Acmæa) incessa, Hds.—R.
Nacella (Acmæa) paleacea, Gld.—R.
Acmæa patina, Esch.—R., A.
† Acmæa persona, Esch.—R., A.
†Acmæa scabra, Nutt.—R., A.
Acmæa spectrum, Nutt.—R.
Acmæa asmi, Midd.—A.
Acmæa crebrifilatum, Cpr.—R.
Acmæa crebrifilatum, var. —R.
Acmæa (Scurria) mitra, Esch.—R., C.
‡Acmæa (Lottia) gigantea, Gray—R., C., A.
Gadenia reticulata, Sby.—R., C., A.
† Fissurella volcano, Rve.—R., A.
Fissurella (Glyphis) aspera, Esh.—R.
* Lucapina crenulata, Sby.—R., C., A.
Fissurellidæ (Clypidella) bimaculata, Dall.—R.
†Haliotis cracherodii, Leach.—R., C., A.
Haliotis corrugata, Gray—R., C., A.
Haliotis rufescens, Sw.—R., C., A.
Phasianella compta, Gld.—R.
Phasianella compta, var. pulloides, Cpr.—R.
* Pomaulax undosus, Wood—R., A., C.
Lepthothyra sanguinea, Cpr.—R.
Lepthothyra bacula, Cpr.—R., A.
Lepthothyra bacula, var.—R.
† Trochiscus norrisii, Sby.—R., A.
Chlorostoma funebrale, Ad.—R., C., A.

FIG. 3.



CHANNEL BETWEEN MIDDLE AND EAST ANACAPAS (LOOKING SOUTH)

Chlorostoma funebrale, var. subapertum, Cpr.—R., A.
† Chlorostoma brunneum, Phil.—R., C., A.
Chlorostoma aureo-tinctum, Fbs.—R.
Chlorostoma gallina, Fbs.—R., C., A.
Calliostoma canaliculatum, Mart.—R.
Calliostoma costatum, Mart.—R.
Calliostoma annulatum, Mart.—R.
Calliostoma gemmulatum, Cpr.—R.
Calliostoma splendens, Cpr.—R.
Margarita acuticostata, Cpr.—R.
Crepidula dorsata, var. lingulata, Gld.—R.
Crepidula adunca, Sby.—R., C.
Crepidula navicelloides, Nutt.—R.
Crepidula navicelloides, var. explanata, Gld.—R.
† Hipponyx antiquatus, Linn.—R., A.
Hipponyx cranioides, Cpr.—R.
Hipponyx tumens, Cpr.—R., A.
Serpulorbis squamigerus, Cpr.—R., A., C.
Bivonia compacta, Cpr.—A.
Spiro-glyphus lituella, Morch ?—A.
† Cerithidea sacrata, Gld.—R.
Bittium filosum, Gld.—R.
Bittium quadrifilatum, Cpr.—R.
Bittium quadrifilatum, var.—R.
Bittium asperum, Cpr.—R.
Littorina planaxis, Nutt.—R., A.
Littorina scutulata, Gld.—R., C., A.
Littorina scutulata, var.—R.
Lacuna variegata, Cpr.—R.
Lacuna unifasciata, Cpr.—R.
Luponia (Cypræa) spadicea, Sw.—R., C., A.
Trivia (Cypræa) californica, Gray—R., A.
Trivia (Cypræa) solandri, Sby.—R.
Erato vitellina, Hds.—R.
Drillia inermis, Hds.—R.
Drillia moesta, Cpr.—R.
Drillia torosa, Cpr.—R.
Drillia torosa, var. aurantii, Cpr.—R.
Mangelia variegata, Cpr.—R.
Mangelia interlirata, Sts.—R.
Mitromorpha aspera, Cpr.—R.
† Conus californicus, Hds.—R., C., A.
Odostomia gravida, Gld.—R.
Chemnitzia tenuicula, Gld.—R.
Scalaria tincta, Cpr.—R., A.
Scalaria sp.—R., A.
Scalaria gracilis, Sby.—R., A., C.
Opalia crenatoids, Cpr. (or nov. sp ?)—A., C.
Cerithiopsis tuberculata, Mont.—R., A.
Cerithiopsis assimilata, C. B. Ad.—A.
† Lunatia lewisii, Gld.—R., C.
Lamellaria stearnsiana, Dall.—R.
Ranella californica, Hds.—A.
* Mitra maura, Sw.—R., A.
Volvarina varia, Sby.—R., A.
* Olivella biplicata, Sby.—R., A.
Nassa fossata, Gld.—R.
Nassa perpinguis, Hds.—R.
Nassa mendica, Gld.—R.
Nassa cooperi, Fbs.—R.
Columbella carinata, Hds., var. Hindsii, Rve.—A.
Amphissa corrugata, Rve.—R., A.
Amphissa corrugata, var. vesicolor, Dall.—R.
Purpura canaliculata, Ducl.—R.
Purpura saxicola, Val.—R.
Purpura saxicola, var. fuscata, Fbs.—R.
Purpura saxicola, var. emarginata, Desh.—R.
Purpura crispata, var. septentrionalis, Rve.—C.
Monoceros engonatum, Conr.—R., A.
Monoceros, var. spiratum, Blain.—R.
Monoceros lapilloides, Conr.—R., A.
Ocinebra lurida, Midd.—R., A.
Ocinebra lurida, var. aspera, Baird—A.
Ocinebra interfossa, var. atropurpurea, Cpr.—R.
Ocinebra interfossa, var. muricata, Coop.—R.

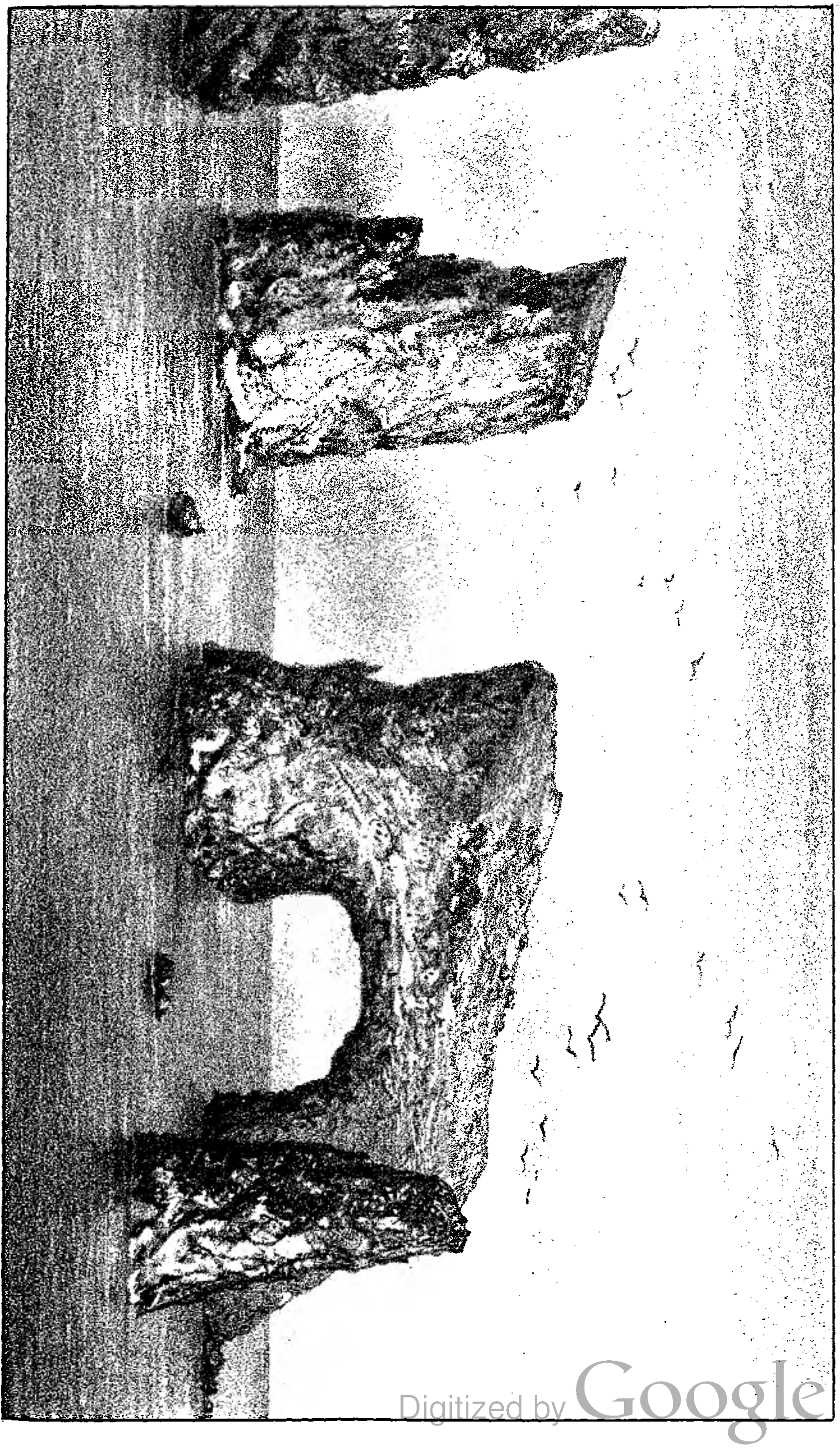
Ocinebra interfossa, var. clathrata, Cpr.—R.
Ocinebra intertexta, Sts.—R., A.
Cerostoma nuttalli, Conr.—A.
Nitidella gouldii, Cpr.—R.
Muricidea fasceolata, Hds.—R.
Muricidea incisa, Brod.—A.
Fusus cinereus, Rve.—A.
Anachis penicillata, Cpr.—R.

Cephalopoda.

Argonanta argo, Linn.—C.
Ommatostrephes gigas, D'Orb.—R.

Doubtless a thorough examination of the shores of these islands would result in the finding of numerous species not included above. Such examinations must necessarily extend over various seasons of the year, and also many years' observations, before a full and complete list of the mollusca could be compiled. Some species appear only at long intervals, and then only under certain conditions, or combinations of favorable circumstances, as to the season of the year, and storms coming from certain directions.

NOTE.—Since the above list was compiled Dr. J. Walter Fewkes has published an illustrated description of a new genus of Nudibranchiata discovered at Santa Cruz Island, which he has named *Cabrilla*, from Cabrillo, the discoverer of the islands. The species is Cabrilla occidentalis, *Fewkes*.



EASTERN EXTREMITY OF ANACAPAS (LOOKING NORTH)

INSULAR FLORAS.

By Dr. Lorenzo G. Yates, F.L.S.

Mr. Alfred R. Wallace, who has written more than any other writer on the subject of differences and variations existing between the floras and faunas of continents and islands, and the general distribution of plants and animals, claims that the floral and faunal variations between islands and the continents to which they are contiguous—widely separated continents, and others which are less distant—involve the study, and illustrate more of the general history of the earth, than any other subject with which we are acquainted; consequently, it represents more fully the great Book of Nature.

By this study we may find pages which, when deciphered, will be more interesting and replete with valuable information to its students than any other line of research in that direction.

Every continent and every island offers problems, the solution of which will present paragraphs and chapters of the past history of the earth.

The correct solution of these problems, based upon the visible and known conditions of the present time, show the combined results of geological, geographical, meteorological, and other changes, which have caused the evolution and distribution of the fauna and flora, not only of the present, but also of all past epochs.

Nature never rests. Annihilation as applied to natural objects is a misnomer. Life and death are but terms applied to phases in the nature of things, which are ever undergoing change.

Change is the life of nature, as circulation and growth are the result of life in plants and animals; and as seemingly insignificant circumstances materially alter the course of the lives of men, so, what we might deem unimportant and scarcely perceptible changes in the condition and surroundings of inorganic matter, eventually affect the organisms of plants and animals. The falling of a tree, the breaking down of a shrub, and even the turning of a stone, affects the condition of some insect or other organism, and the results of the change will continue through all time. Every portion of the surface of the earth is exposed to the changing influences of sun, wind, rain, frost, and snow, which, by their direct action, or by attrition, caused by particles being brought in contact with other substances, form new combinations and changes in its topography.

There are regularly recurring cycles of climatic changes, corresponding to the diurnal and annual changes of relationship between the earth and sun, which eccentricities, as they have been termed, extend over so great a period of time that we cannot measure them with any degree of certainty. These eccentricities have been less marked during the period of which we have any satisfactory knowledge back to perhaps sixty thousand years ago, which period has been marked by a comparative stability of climate, and may represent the prime of life of our earth, and may be followed by a decline, manifested by a gradual diminution of the forces which have evolved and developed organic life, a more rapid and gradually increasing modification, disintegration, and distribution of the inorganic matter, corresponding with the decline of organic life, until the earth shall cease to exist as a planet, and return to a gaseous or nebulous state, to be again distributed in space, and incorporated with other matter of like character and formed into new worlds, thus continually carrying out the everchanging condition of forces and matter which we call Nature.

The floras of some high and isolated mountain peaks also present interesting chapters in the earth's history. The summit of the White Mountains, in New Hampshire, has a vegetation, every plant of which is identical with species growing in Labrador, and the butterflies are also Arctic species; the highest peaks of the Alps and the Pyrenees contain a number of plants like those of Labrador, and some of the high volcanic peaks of Java produce plants allied to those of Europe, while the lowlands for thousands of miles are occupied by a flora of an entirely different character. These mountains produce living representatives of the plants which occupied the surrounding country during the glacial epoch, when the present temperate regions were subjected to intense cold. The gradual return of the warm climate caused remnants of the Arctic flora to recede from the valley, up the slopes of the mountains, at the summits of which are now found species identical with those found growing in the present Arctic region, while their former places, at lower altitudes, are now occupied by floras of temperate or tropical climates. The discovery of large numbers of fossil plants of a well marked tropical character in Greenland, Alaska, etc., shows that at a time still more remote the present Arctic regions enjoyed the benefits of a tropical climate.

We have in California interesting and well marked illustrations of the peculiarity and individuality, as it were, of insular floras.

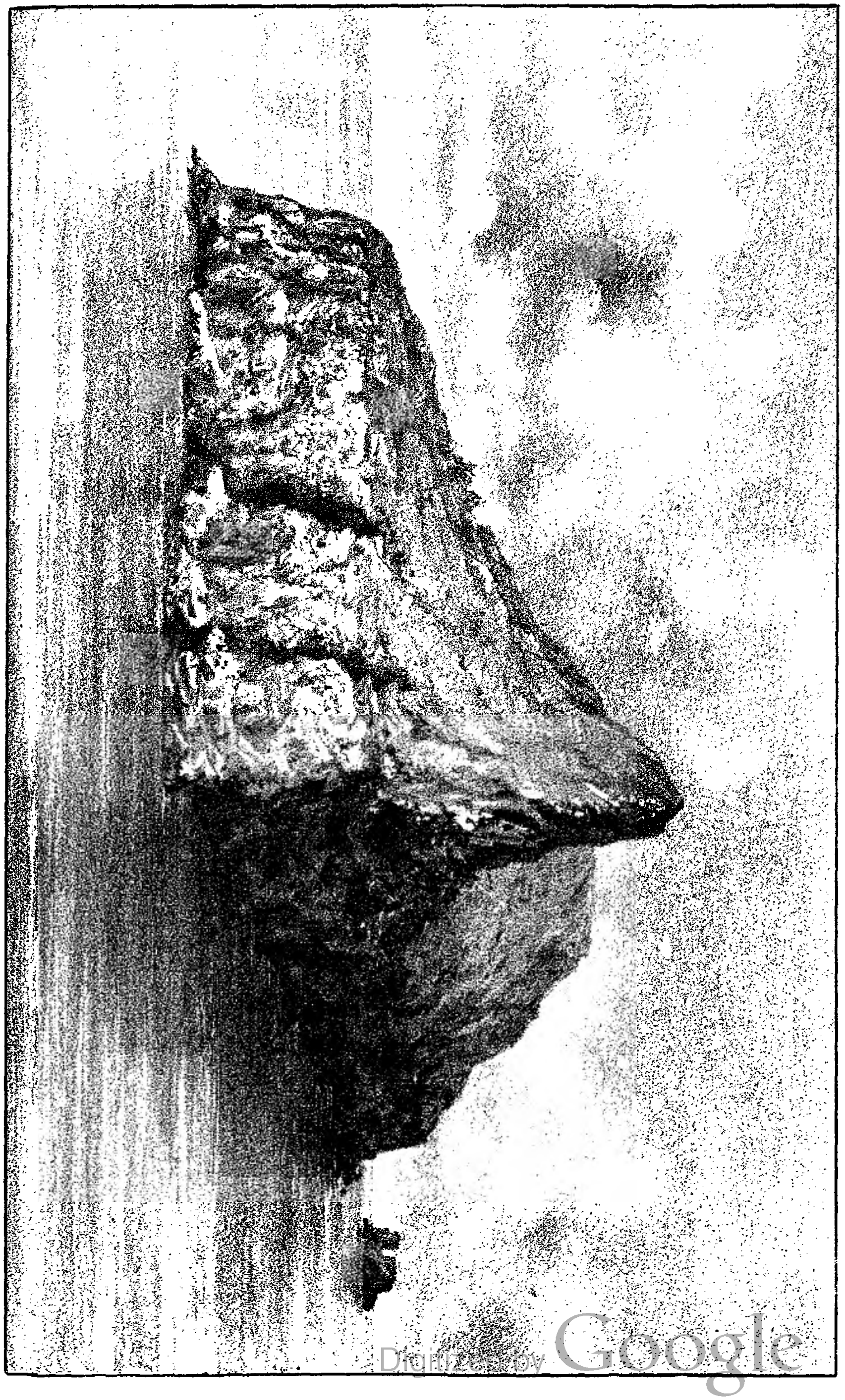
The islands of San Miguel, Santa Rosa, Santa Cruz, and the Anacapas, which form the seaward or southern wall of Santa Barbara Channel, although but partially explored, have already furnished our botanists with a long list of new and (except on these islands) unknown plants. Prof. E. L. Greene, during a short stay upon Santa Cruz Island in 1886, discovered twenty-eight species of plants peculiar to that island, so far as our present knowledge goes, and twenty of which are peculiar to Santa Cruz and the other islands off our coast. Professor Greene remarks that "a small ridge of mountains rising out of the sea at only twenty-five miles distant from the mainland shore should present forty-eight species of phanerogamic plants not to be found on the continent itself is, to my understanding of the case, a fact entirely unique in phytogeography, and I cannot but wonder if competent geological authority will not, after careful investigation, assure us that this group of islands has a very peculiar geological origin and history."

Professor Greene also considers that the several distinctively Californian species of Dendromecon, Eschscholtzia, Thysanocarpus, and Zauschneria have been carried from the islands to the mainland, and that several of the rare species of our southern counties have also been distributed from Santa Cruz.

The two new generic types, which are endemic on the islands, are the Lyonothamnus and Hazardi. The genus Lavatera is not represented on Santa Cruz, but the more southern islands have given us four species. The question is how did those insular genera and species orignate?

These islands are of comparatively recent geological formation, perhaps of the miocene tertiary. As no living nor fossil representatives of these species have been found elsewhere, we must infer that they originated on these islands; consequently the genera and species have evolved or been created within recent geological epochs. It would also indicate that new

FIG. 4.



DISTANT VIEW OF WEST ANACAPA (LOOKING N.E.)

species are continually being evolved in, and distributed from, various centers or portions of the earth's surface.

The Lyonothamnus is a tree with a beautiful and, as the name of one of the species (Asplenifolia) indicates, fern-like foliage, and special effort should be made to cultivate and distribute it.

I herewith append a tabulated list of the known flora of the Channel Islands, showing the collections made by Prof. E. L. Greene, Prof. Brandegee, Prof. H. C. Ford, and Dr. L. G. Yates:

TABULATED LIST OF THE KNOWN FLORA OF THE CHANNEL ISLANDS OFF THE COAST OF SOUTHERN CALIFORNIA, TO 1890.

Note.—The initials in the spaces under the names of the different islands indicate who has collected the species on the particular island, and where more than one individual has collected the species on the same island, the initial of the name of each collector is given.

G.—Indicates Prof. E. L. Greene.
B.—Indicates Prof. Brandegee.
F.—Indicates Prof. H. C. Ford.
Y.—Indicates Dr. L. G. Yates.

	San Miguel.	Santa Rosa.	Santa Cruz.	Anacapas.
Clematis ligusticifolia, *Nutt.*		B.	G.	
Ranunculus Californicus, *Benth.*		B.		
Ranunculus Deppei, *Nutt.*	G.		G.	
Delphinium Parryi		B.		
Berberis pinnata, *Lagasca*			G.	
Platystemon Californicus, *Benth.*	G.	B.	G.	
Platystigma denticulatum, *Greene*			G.	
Meconopsis heterophylla, *Benth.*			G., F.	
Dendromecon flexile, *Greene*		B.	F., Y.	
Eschscholtzia glauca, *Greene*		B.	G.	
Eschscholtzia maritima, *Greene*	G.			
Eschscholtzia ramosa, *Greene*			G.	
Cardamine integrifolia, *Torr. & Gray*			G.	
Arabis filifolia, *Greene*			G.	
Arabis perfoliata, *Lam.*			B.	
Arabis arcuata, *Gray*			B.	
Thelypodium lasiophyllum, *Greene*	G.		G.	
Thelypodium laciniatum, *Endl.*			F.	
Sisymbrium pinnatum			G.	
Sisymbrium officinale, *Scop.*			G.	
Sisymbrium reflexum, *Nutt.*		B.		
Erysimum insulare, *Greene*	G.	B.		
Erysimum asperum, *DC.*			B.	
Brassica campestris, *Linn.*	G.		B.	
Brassica nigra, *Boiss.*			G.	
Nasturtium aquaticum, *Tragus.*			G.	
Capsella divaricata, *Walp.*	G.	B.	G.	
Capsella Bursa-pastoris, *Mœnch*			G.	
Lepidium nitidum, *Nutt.*			G.	
Lepidium lasiocarpum, *Nutt.*	G.			
Lepidium lasiophyllum, *Nutt.*		B.		
Lepidium Menziesii, *DC.*			G.	
Thysanocarpus conchuliferus, *Greene*			G.	
Thysanocarpus ramosus, *Greene*			G.	
Isomeris arborea, *Nutt.*		B.		
Athysanus pusillus, *Greene*			G.	
Viola pedunculata, *Torr. & Gray*		B.		
Oligomeris subulata, *Boiss.*	G.		G.	
Helianthemum scoparium, *Nutt.*		B.	G.	
Helianthemum occidentale, *Greene*			G.	
Frankenia grandifolia, *Cham. & Sch.*	G.	B.	G.	Yates.
Arenaria Douglasii, *Torr. & Gray*			B.	
Silene simulans, *Greene*	G.			
Silene conoidea, *L.*			B.	
Silene anirrhina, *Linn.*	G.		G.	
Silene Gallica, *Linn.*	G.	B.	G.	
Silene quinquevulnera, *Linn.*			G.	

List of the Known Flora—Continued.

	San Miguel.	Santa Rosa.	Santa Cruz.	Anacapas.
Silene laciniata, *Cav.*	G.		G.	Yates.
Stellaria media, *Sm.*		B.	G.	
Sagina occidentalis, *Watson*		B.	G.	
Lepigonum macrothecum, *Fisch & Mey.*	G.		G.	
Pentacæna ramosissima, *Hook*		B.	G.	
Calandrinia maritima, *Nutt.*			B.	
Calandrinia Menziesii, *Hook*			G.	
Calandrinia Brewerii, *Watson*			B.	
Claytonia perfoliata, *Donn.*		B.	G.	
Malva parviflora, *Linn.*		B.	G.	
Lavatera assurgentiflora, *Kellogg*	G.	Y.		
Sidalcea malvæflora, *Gray*	G.	B.		
Malvastrum Thurberi, *Gray*, var. laxiflorum, *Gray*			G.	
Malvastrum exile, *Gray*			B.	
Erodium cicatarium, *l'Her.*	G.	B.	G.	
Erodium moschatum, *Willd*	G.		G.	
Erodium macrophyllum, *Hook & Arn.*			B.	
Rhamnus insularis, *Kellogg*	G.		G.	
Ceanothus crassifolius, *Torr.*	G.	B.	G.	
Ceanothus arboreus, *Greene*		B.	G.	
Acer macrophyllum, *Pursch.*			G.	
Rhus diversiloba, *Torr. & Gray*	G.	B.	G.	
Rhus integrifolia, *Benth.*	G.	B.	G.	
Rhus ovata, *Watson*			G.	
Lupinus arboreus, *Linn.*	G.			
Lupinus Chamissonis, *Esch.*	G.	B.	G.	
Lupinus affinis, *Agh.*			G.	
Lupinus nanus, *Dougl.*			G.	
Lupinus truncatus, *Nutt.*			G.	
Lupinus hirsutissimus, *Benth.*			G.	
Lupinus umbellatus, *Greene*		B.	G.	
Lupinus microcarpus, *Linn.*			G.	
Lupinus concinnus, *Agardh.*			B.	
Oxalis Wrightii, *Gray*			B.	
Geranium Carolinianum, *L.*			B.	
Astragalus nigrescens, *Nutt.*			B.	
Astragalus Miguelensis, *Greene*	G.	B.		Yates.
Astragalus lucopsis, var. brachypterus, *Greene*	G.			
Astragalus didymocarpus, *Hook & Arn.*			G.	
Astragalus lucopsis, *Torr. & Gray*			G.	
Medicago sativa, *Linn.*	G.			
Medicago denticulata, *Willd.*	G.		G.	
Melilotus parviflora, *Desf.*	G.	B.	G.	
Godetia purpurea, *Watson*			G.	
Godetia quadrivulnera, *Spach.*		B.	B.	
Godetia epilobioides, *Watson*			G., F.	
Œnothera nitida, *Greene*	G.			
Œnothera Hookeri, *Torr. & Gray*			G.	
Œnothera micrantha, *Hornem*			Ford.	
Œnothera dentata, *Cav.*		B.		
Œnothera bistorta, *Nutt.*	G.	B.	G.	
Œnothera cheiranthifolia, *Hornem*	G.	B.	G.	
Syrmatium dendroideum, *Greene*		B.	G., F.	
Syrmatium patens, *Greene*	G.		G.	
Syrmatium niveum, *Greene*			G.	
Trifolium tridentatum, *Lindl.*			F.	
Trifolium microcephalum, *Pursh.*			F.	
Hosackia occulta, *Greene*			G.	
Hosackia grandiflora, *Benth.*			B.	
Hosackia parviflora, *Benth.*			G.	
Hosackia strigosa, *Nutt.*		B.	G.	
Hosackia maritima, *Nutt.*		B.	G.	
Hosackia subpinnata, *Torr. & Gray*			G.	
Hosackia Purshiana, *Benth.*			G.	
Vicia Americana, *Muhl.*			G.	
Vicia exigua, *Nutt.*	G.		G., F.	
Pickeringia montana, *Gray*			B.	
Lathyrus vestitus, *Nutt.*			G.	
Prunus occidentalis, *Lyon*		B.	G.	

List of the Known Flora—Continued.

	San Miguel.	Santa Rosa.	Santa Cruz.	Anacapas.
Rubus ursinus, *Cham.*	G.	B.	G.	
Cercocarpus betulæfolius, *Nutt.*			G.	
Potentilla anserina, *Linn.*	G.			
Adenostoma fasciculatum, *H. & A.*		B.	G.	
Rosa Californica, *Cham. & Schl.*		B.	G.	
Spiræa discolor, *Pursh.*			B.	
Heteromeles arbutifolia, *Ræmer*	G.	B.	G.	
Lyonothamnus asplenifolius, *Greene*			G., F., Y.	
Alchemilia arvensis, *Scopoli*			B.	
Saxifraga malvæfolia, *Greene*			G.	
Saxifraga reflexa, *Hook*			B.	
Hauchera maxima, *Greene*		B.	G.	
Ribes subvestitum, *Hook & Arn.*			G.	
Ribes sanguinea, *Pursh.*; var. malvaceum, *Gray*			B.	
Ribes Menziesii, *Pursh.*			B.	
Tellima cymbalaria, *Gray*			B.	
Tillæa minima, *Miers*		B.	G., F.	
Cotyledon lanceolata, *Watson*	G.	B.	G.	Yates.
Cotyledon laxa, *Watson*			G.	
Lythrum Californicum, *T. & G.*			G.	
Zauschneria Californica, *Presl.*	G.	B.	G.	
Zauschneria villosa, *Greene*			G.	
Zauschneria cana, *Greene*			G.	
Epilobium coloratum, *Muhl*			G.	
Eulobus Californicus, *Nutt.*			G.	
Clarkia elegans, *Dougl.*		B.	G.	
Mentzelia micrantha, *Greene*		B.	G.	
Echinocystis macrocarpa, *Greene*	G.	B.	G.	
Echinocystis Guadalupensis, *Cogn.*	G.		G.	
Cereus				Yates.
Opuntia Engelmanni, *Salm.; var.?* littoralis, *Engelm.*	G.	B., Yates.	G.	Yates.
Mesembrianthemum aequilaterale, *Haw.*	G.		G.	
Mesembrianthemum crystallinum, *Linn.*	G.	B., Y.	G.	
Sanicula laciniata, *Hook & Arn.*			G.	
Conium maculatum, *Linn.*			G.	
Fœniculum officinale, *All.*			G.	
Apiastrum augustifolium, *Nutt.*	G.		G., Ford.	
Berula augustifolia, *Koch.*	G.		G.	
Peucedanum caruifolium, *Torr. & Gray*		B.	B.	
Daucus pusillus, *Michx.*	G.	B.	G., F.	
Sambucus glauca, *Nutt.*		B.	G.	
Symphoricarpus mollis, *Nutt.*		B.	G.	
Lonicera hispidula, *Dougl.*			G.	
Lonicera subspicata, *Hook & Arn.*		B.	G.	
Galium aparine, *Linn.*		B.	G.	
Galium augustifolium, *Nutt.*		B.	G.	
Galium flaccidum, *Greene*			G.	
Galium buxifolium, *Greene*	G.		G.	
Galium Nuttallii, *Gray*			B.	
Galium Miguelensis, *Greene*	G.	B.		
Brickellia Californica, *Gray*			G.	
Grindelia robusta, *Nutt.*			G.	
Grindelia latifolia, *Kellogg*		B.	G.	
Anthemis colula, *L.*		B.		
Aplopappus squarrosus, *Hook & Arn.*			G.	
Aplopappus ericoides, *Hook & Arn.*	G.			
Bigelovia veneta, *Gray*	G.	B.	G.	
Bigelovia veneta, var. sedoides, *Greene*	G.		G.	
Solidago Californica, *Nutt.*		B.	G.	
Corethrogyne filaginifolia, *Nutt.*		B.	G.	
Corethrogyne filaginifolia, var. robusta, *Greene*	G.			Yates.
Hazardia detonsa, *Greene*		B.	G.	
Hazardia serrata, *Greene*		B.	G.	
Aster foliaceus, *Lindl.*		B.		
Aster radulinus, *Gray*			G.	
Erigeron canadensis, *Linn.*			G.	
Erigeron glaucus, *Ker.*	G.	B.	G.	Yates.
Erigeron stenophyllus, *Nutt.*	G.		G.	

List of the Known Flora—Continued.

	San Miguel.	Santa Rosa.	Santa Cruz.	Anacapas.
Erigeron foliosus, *Nutt.*		B.		
Erigeron sancturum, *Wats.*		B.		
Conyza Coulteri, *Gray*			G.	
Baccharis pilularis, *DC.*		B.		
Baccharis consanguinea, *DC.*			G.	
Baccharis plummeræ, *Gray*			G.	
Baccharis Douglasii, *DC.*		B.	G.	
Baccharis viminea, *DC.*			G.	
Bæria gracilis, *Gray*		B.	B., F.	Yates.
Bæria Palmeri, var. Clementina, *Gray*		B.	G.	
Micropus Californicus, *F. & M.*			G., F.	
Microseris Lindleyi, *Gray*		B.	B.	
Microseris elegans, *Greene*			B.	
Microseris linearifolia, *Torr. & Gray*		B.		
Microseris anomala, *Watson*			B.	
Filago Californica, *Nutt.*		B.	G., F.	
Gnaphalium sprengelii, *Hook & Arn.*	G.	B.	G.	
Gnaphalium ramosissimum, *Nutt.*			G.	
Gnaphalium decurrens, var. Californicum, *Gray*		B.	G.	
Gnaphalium purpureum, *Linn.*		B.	G.	
Ambrosia psilostachya, *DC.*			G.	
Franseria bipinnatifida, *Nutt.*	G.		G.	
Franseria Chamissonis, *Less.*	G.			
Xanthium canadense. *Mill.*			G.	
Helianthus annuus, *Linn.*			G.	
Encilia Californica, *Nutt.*			G.	
Leptosyne gigantea, *Kellogg*	G.	B.	G.	Yates.
Madia filipes, *Gray*			G., Ford.	
Madia sativa, *Molina*		B.		
Madia dissitifolia, *Torr. & Gray*			B.	
Hemizonia fasciculata, *Torr. & Gray*	G.	B.	G.	
Hemizonia paniculata, *Gray*		B.		
Achyrachæna mollis, *Schauer*			G.	
Layia platyglossa, *Gray*	G.	B.	G., F.	
Venegasia carpesioides, *DC.*		B.	G.	
Perityle Fitchii, *Torr.*			G.	
Eriophyllum confertiflorum, *Gray*	G.		G.	
Eriophyllum stachdifolium, *Greene*		B.	G.	
Amblyo pappus pusillus, *Hook & Arn.*	G.	B.	G.	Yates.
Achillea Millefolium, *Linn.*	G.	B.	G.	
Artemisia Californica, *Less.*	G.	B.	G.	Yates.
Artemisia Ludoviciana, *Nutt.*		B.	G.	
Lepidospartum squamatum, *Gray*			G.	
Styloclime gnaphaloides, *Nutt.*		B.	B.	
Matricaria discoidea, *DC.*			B.	
Senecio vulgaris, *L.*			B.	
Senecio Douglasii, *DC.*			G.	
Cnicus lilacinus, *Greene*	G.			
Cnicus occidentalis, *Gray*	G.			
Chænactis tenuifolia, *Nutt.*		B.		
Silybum marianum, *Gært.*			G.	
Centaurea melilensis, *Linn.*	G.	B.	G.	
Perezia microcephala, *Gray*		B.	G.	
Stephanomeria elata, *Nutt.*			G.	
Stephanomeria exigua, *Nutt.*		B.		
Stephanomeria virgata, *Benth.*	G.	B.	G.	
Stephanomeria tomentosa, *Greene*			G.	
Stephanomeria cichoriacea, *Gray*			G.	
Rafinesquia Californica, *Nutt.*			G.	
Hypochæris glabra, *Linn.*			G.	
Calais linearifolia, *DC.*			G.	
Calais pluriseta, *Greene*			G.	
Malacothix tenuifolia, *Torr. & Gray*	G.		G.	Yates.
Malacothix Coulteri, *Gray*			B.	
Malacothix incana, *Torr. & Gray*	G.	B.	G.	
Malacothix Clevelandi, *Gray*			B.	
Malacothix indecora, *Greene*	G.		G.	
Malacothix saxatalis, *Torr. & Gray*		B.		
Malacothix squalida, *Greene*			G.	

List of the Known Flora—Continued.

	San Miguel.	Santa Rosa.	Santa Cruz.	Anacapas.
Jaumea carnosa, *Gray*	G.			
Hieracium argutum, *Nutt.*		B.	G.	
Troximon grandiflorum, *Gray*		B.		
Troximon heterophyllum, *Greene*			G.	
Sonchus oleraceus, *Linn.*		B.	G.	
Sonchus asper, *Fuchs*		B.	G., F.	
Specularia biflora, *Gray*			B.	
Specularia perfoliata, *A. DC.*			G.	
Vaccinium ovatum, *Pursh.*			G.	
Arctostaphylos tomentosa, *Dougl.*		B.	G.	
Arctostaphylos pungens, *H. B. K.*		B.	G.	
Arctostaphylos diversifolia, *Parry*		B.	G.	
Arctostaphylos Stanfordi, *Parry*			Ford.	
Dodecatheon Hendersoni, *Gray*		B.		
Dodecatheon Jeffreyi, *Moore*			G.	
Samolus Valerandi, var. Americanus, *Gray*			G.	
Erythræa Douglasii, *Gray*		B.	G.	
Gilia androsacea, *Steud.*		B.	B.	
Gilia filifolia, *Nutt.*			G.	
Gilia dianthoides, *Endl.*			B.	
Gilia micrantha, *Steud.*	G.			
Gilia Nevinii, *Gray*		B.	B.	
Gilia multicaulis, *Benth.*			G.	
Nemophila aurita, *Lindl.*			B.	
Nemophila parviflora, *Dougl.*			B.	
Nemophila racemosa. *Nutt.*			G.	
Eucrypta chrysanthemifolia, *Greene*	G.	B.	G.	
Phacelia distans, *Benth.*		B.	B.	
Phacelia viscida, *Torr.*	G.	B.	B.	
Phacelia ramosissima, *Dougl.*		B.		
Phacelia scabrella, *Greene* (=distans?)	G.	B.		
Phacelia hispida, *Gray*			G.	
Phacelia suffrutescens, *Parry*			G.	
Phacelia Parryi, *Torr.*			G.	
Phacelia Douglasii, *Torr.*			Ford.	
Emmenanthe penduliflora, *Benth.*			G.	
Pectocarya penicillata, *A. DC.*			G.	
Krynitzkia leiocarpa, *Fisch. & M.*	G.	B.	G.	
Krynitzkia micromeres, *Gray*			G.	
Krynitzkia Jonesii, *Gray*			G.	
Plagiobothrys canescens, *Benth.*			B.	
Plagiobothrys Californicus, *Gray*			G.	
? Pectocarya penicillata, *A. DC.*			Ford.	
Heliotropium Curassavicum, *Linn.*	G.		G.	
Amsinckia lycopsoides, *Lehm.*	G.		G.	
Amsinckia intermedia, *F. & M.*		B.	G.	
Cressa cretica, *Linn.*	G.			
Convolvulus pentapetaloides, *L.*			B.	
Convolvulus macrostegius, *Greene*	G.	B.	G.	Yates.
Convolvulus arvensis, *Linn.*			G.	
Cuscuta subinclusa, *Dur. & Hil.*			G.	
Dichondra argentea, *Willd.*		B.		
Solanum Douglasii, *Dunal.*	G.	B.	G.	
Solanum Xanti, var. Wallacei, *Gray*		B.	G.	
Datura meteloides, *DC.*			G.	
Nicotiana Clevelandi, *Gray*			G.	
Linaria canadensis, *Dum.*		B.	G.	
Antirrhinum nuttallianum, *Benth.*	G.	B.	G.	
Antirrhinum strictum, *Gray*			G.	
Penstemon cordifolius, *Benth.*		B.	G.	
Diplacus arachnoideus, *Greene*		B.	G.	
Diplacus parviflorus, *Greene*		B.	G.	
Mimulus cardinalis, *Dougl.*			G.	
Mimulus latifolius, *Gray*			B.	
Mimulus nasutus, *Greene*		B.	G.	
Mimulus floribundus, *Dougl.*			G.	
Mimulus lutens, *L.*			B.	
Castilleia affinis, *Hook & Arn.*			G.	Yates.
Castilleia hololeuca, *Greene*	G.	B.	G.	Yates.

List of the Known Flora—Continued.

	San Miguel.	Santa Rosa.	Santa Cruz.	Anacapas.
Castilleia parviflora, *Brong.*		B.	B., Ford.	
Orthocarpus densiflorus, *Benth.*	G.		G.	
Orthocarpus purpurascens, *Benth.*		B.		
Collinsia bicolor, *Benth.*		B.		
Aphyllon fasciculatum, *Gray*			B.	
Aphyllon tuberosum, *Gray*		B.	G.	
Verbena prostrata, *R. Br.*	G.		G.	
Sphacele fragrans, *Greene* Sphacele calycina, *Benth.?*		B.	G.	
Salvia Columbariæ, *Benth.*		B.	G.	
Audibertia Palmeri, *Gray*			G.	
Audibertia nivea, *Benth.*			B.	
Audibertia stachyoides, *Benth.*			B.	
Audibertia stachyoides, var. revoluta		B.		
Stachys acuminata, *Greene*			G.	
Scutellaria tuberosa, *Benth.*			B.	
Marrubium vulgare, *Linn.*	G.			
Plantago major, *Camerarius*			G.	
Plantago patagonica, *Jacq.*	G.	B.	G.	
Plantago hirtella, *H. B. K.*	G.			
Salicornia ambigua, *Michx.*	G.	B.	G.	
Eriogonum grande, *Greene*		B.	G.	
Eriogonum rubescens, *Greene*	G.	B.	G.	
Erigonum arborescens, *Greene*		B.	G.	Yates.
Rumex salicifolius, *Weinn.*	G.	B.	G.	
Rumex crispus, *Linn.*			G.	
Rumex maritimus, *Linn.*	G.		G.	
Rumex conglomeratus, *Murr.*			G.	
Polygonum aviculare, *Linn.*		B.	G.	
Chorizanthe staticoides, *Benth.*		B.	G.	
Pterostegia drymarioides, *F. & M.*		B.	G.	
Mirabilis Californica, *Gray*			G.	
Abronia maritima, *Nutt.*	G.		G.	
Abronia umbellata, *Lam.*	G.	B.	G.	
Amarantus albus, *Linn.*			G.	
Chenopodium murale, *Linn.*			G.	
Chenopodium album, *Linn.*	G.	B.	G.	
Chenopodium ambrosioides, *Linn.*		B.	G.	
Chenopodium Californicum, *Watson*	G.		G.	
Atriplex microcarpa, *Dietr.*			G.	
Atriplex Californica, *Moq.*	G.	B.	G.	
Atriplex leucophylla, *Dietr.*	G.		G.	
Atriplex Breweri, *Watson*			G.	Yates.
Suæda Torreyana, *Watson*	G.		G.	
Urtica holosericea, *Nutt.*			G.	
Urtica urens, *Linn.*			G.	
Parietaria debilis, *Forst.*		B.	G, Ford.	
Eremocarpus setigerus, *Benth.*			G.	
Ricinus communis, *Linn.*			G.	
Salix lævigata, *Bebb.*		B.	G.	
Salix longifolia, *Muhl*			G.	
Salix lasiolepis, *Benth.*			G.	
Populus Fremonti, var. Wislizeni, *Watson*			B.	
Populus trichocarpa, *Torr.*		B.	G.	
Quercus agrifolia, *Liebm.*		B.	G.	
Quercus chrysolepis, *Liebm.*			G.	
Quercus dumosa, *Nutt.*		B.	G.	
Quercus lobata, *Nee.*		B.	B.	
Quercus parvula, *Greene*			G.	
Quercus tomentella, *Englm.*		B.	G.	Only k'wn loc. in U.S.
Pinus insignes, *Doug.*; var. binata, *Englm.*		B.	G., F., Y.	
Pinus Torreyana, *Parry*		B., Y.		
Allium lacunosum, *Watson*		B.	B.	
Allium hyalinum, *Curran*			B.	
Calochortus albus, *Dougl.*		B.	B.	
Calachortus venustus, *Benth.*			B.	
Brodiæa minor, *Watson*			B.	
Brodiæa insularis, *Greene*	G.	B.	G.	

List of the Known Flora—Continued.

	San Miguel.	Santa Rosa.	Santa Cruz.	Anacapas.
Habenaria elegans, *Bolander*		B.	G.	
Sisyrinchium bellum, *Watson*	G.	B.	G.	
Bloomeria aurea, *Kellogg*		B.	G.	
Lilium Humboldtii, *Roezl.*		B.	G.	
Luzula comosa, *Meyer*		B.	B.	
Zygadenus Fremonti, *Torr.*		B.	G.	
Juncus patens, *Meyer*		B.		
Juncus balticus, *Deth.*	G.	B.	G.	
Juucus effusus, *Linn.*			G.	
Juncus bufonius, *Linn.*		B.	G.	
Typha bracteata, *Greene*			G.	
Zostera marina, *Linn.*			G.	
Phyllospadix Torreyi, *Watson*		B.	G.	
Carex angustata, *Boot.*			G.	
Carex Douglasii, *Boot.*		B.		
Carex globosa, *Boot.*			B.	
Scirpus pungens, *Bahl.*		B.		
Scirpus riparius, *Spreng.*			B.	
Agrostis Scouleri, *Trin.*		B.		
Agrostis verticillata, *Vill.*		B.		
Bromus ciliatus, *L.?*			B., Ford.	
Bromus Hookerianus, *Thurb.*		B.	B.	
Kœleria cristata, *Pers.*		B.	B.	
Festuca myurus, *Linn.*	G.	B.	G.	
Festuca microstachys, *Nutt.*		B.	B.	
Festuca tenella, *Willd.*			B.	
Muhlenbergia debilis, *Trin.*			G., F.	
? Poa steriantha, *Trin.*			Ford.	
Poa annua, *L.*			B.	
Poa Howellii, *V. & S.*			B.	
Phalaris intermedia *Bosc.*			B.	
Trisetum barbatum, *Steud.*			B.	
Stipa setigera, *Presl.*		B.	B.	
Stipa eminens, *Cav.*			B.	
Stipa viridula, *Trin.*			B.	
Polypogon Monspeliensis, *Desf.*	G.	B.	G.	
Avena fatua, *Linn.*	G.		G.	
Melica imperfecta, *Trin.*			G.	
Distichlis spicata, *Linn.*	G.	B.	G.	
Elymus condensatus, *Presl.*	G.	B.	G.	
Agropyrum repens, *Beauv.*	G.	B.	G.	
Hordeum murinum, *Linn.*		B.	G.	Yates.
Equisetum Telmateia, *Ehrh.*			B.	
Polypodium Californicum, *Kaulf.*		Yates, B.	F., G., Y.	
Polypodium Scouleri, *H. & G.*			Yates.	
Pellæa ornithopus, *Hook*			F., G., Y.	
Pellæa andromedæfolia, *Fee.*		Yates, B.	F., G., Y.	
Pellæa andromedæfolia, var.			Y.	
Cheilanthes Californica, *Melt.*			G.	
Cheilanthes myriophylla, *Desn.*			F., B., Y.	
?Notholnæa candida, *Hook*			G.	
Pteris aquilina, *Linn.*		Y., B.	F., G., Y.	
Adiantum pedatum, *Linn.*			F., G., Y.	
Adiantum capillus-veneris, *Linn.*			G.	
Adiantum emarginatum, *Hook*		Y., B.	B., Y.	
Woodwardia radicans, *Sm.*			F., G., Y.	
Aspidium munitum, *Kaulf.*			G.	
Aspidium regidum, *Swtz.*		Y., B.	F., G., Y.	
Gynmogramme triangularis, *Kaulf.*		Yates, B.	B., F.	
Gymnogramme triangularis, var.			Y.	
Selaginella rupestris, *Spring.*			B.	
Eriogonum latifolium, *Sm.*				Yates.
Hemizonia Streetsii, *Gray*				Yates.

Note.—Hemizonia Streetsii, *Gray*, heretofore collected only on Santa Catalina and San Clemente Islands by W. S. Lyon, collected by L. G. Yates on Anacapas, is new to the Channel Group.

Lichens Collected on Anacapas by H. C. Ford and L. G. Yates, determined by Prof. W. G. Farlow.

	Anacapas.
Rawalina ceruchis, *Achs.*	F., Y.
Rawalina howalea, *Ach.*	F., Y.
Placodaim aurantiacum, *N. & H.*	F., Y.
Rocella leucophœa, *Tuck.*	F., Y.
Rocella phycopsis, *Mont.*	F., Y.
Buellia pullata, *Tuck.*	F., Y.

LOS ANGELES COUNTY.

By E. B. Preston, E.M., Assistant in the Field.

Los Angeles County is situated between 33 degrees 25 minutes and 34 degrees 50 minutes north latitude, and 40 degrees 36 minutes and 41 degrees 55 minutes west longitude from Washington; therefore one of the southern counties of California. The general shape of the county is a parallelogram seventy miles long, from north to south, with a triangle added in the southeast portion, whose north line is seventy miles and east line forty miles.

It is bounded on the north by Kern County, on the east by San Bernardino County, south by San Diego County, and west by Ventura County and the ocean. It comprises an area of five thousand six hundred square miles, or about three million five hundred and eighty-four thousand acres, a large proportion of which is mountainous, and in the northern portions it is covered to some extent by the Mojave Desert. On the ocean side it has a shore line extending ninety miles, but without any prominent harbor. Santa Monica Bay and Ballona Harbor can be made into good harbors.

It has three principal rivers—the Santa Ana, which rises in San Bernardino County and runs west and south through Los Angeles County until it approaches the ocean, where it spreads out and, running parallel with the sea for some distance, finally discharges into the ocean near Newport. The San Gabriel takes its source in the San Bernardino Range. It has two forks, of which the west fork rises in Township 2 north, Range 11 west, S. B. M., and the different creeks that go to form the east branch take their rise in the mountains forming the southern boundary of the desert, in Township 3 north, Range 8 west, S. B. M. The two forks unite in Section 29, Township 2 north, Range 8 west, S. B. M., and flow thence south until they reach the ocean at Alamitos Bay. The Los Angeles River rises in the mountains near the Ventura County line, and running thence east and south, sinks in the neighborhood of Compton.

All of these streams, on the upper part of their course, are torrential, contributing thereby largely to the topographical changes that take place on the mountain flanks and in the cañons, causing denudations of large areas in one place and throwing up accumulations of wash and debris in others. Changes of the water level of ten and twelve feet in less than half an hour in the cañons are frequently recorded. Yet, notwithstanding the large amount of water that passes over these river-beds for the greater part of the year, the water sinks beneath the surface before reaching the ocean.

The mountain ranges are in the northeast—the San Bernardino Range, the main east and west ranges known as the Sierra Santa Inez; the Sierra Santa Monica, which flanks the coast extending from the ocean to the Cahuengo Pass. The Sierra Santa Susanna is north of San Fernando Valley. The principal northwest and southeast chains are less clearly defined as separate ranges; the principal portion is known as the Santa Lucia Range. It extends as a succession of high mountain crests from northeast of San Luis Obispo to Carmelo Bay, a distance of nearly one hundred miles. The southeast end terminates in the Arroyo Grande. This whole chain with its outlying spurs is called on the Pacific railroad map Sierra de las Salinas.

The general trend of the east and west ranges is north 60 degrees west, and this seems to be the line of upheavals which mark the northeast limit of the coast ranges along the line of the desert. The region embraced between these hills is in general poorly supplied with water, the hills covered with a dense growth of chaparral, and with a forest growth on the side next to the ocean. The backbone of the main ranges consists of metamorphic rocks, syenites, gneiss, micaceous schists, with dikes of diorite.

A large part of the northeast of the county, comprising about twenty townships, is occupied by the Mojave Desert, a flat, sandy country cut up by ranges of low-lying hills of tertiary origin, without water.

METALS AND MINERALS.

The mineral and metallic productions of the county include gold, silver, copper, asphaltum, petroleum, graphite, iron, limestone, gypsum, borate of lime, magnesia, kaolin, borax, alum, salt, building stones, such as granite, sandstone, marble, etc. Also clays suitable for mineral paints, fire-clay, coal (poor quality), and cement.

Yet with all this wealth lying within her borders, the production of Los Angeles County, in any one of these materials, with the exception of petroleum, is insignificant. One cause for this may be found in the extremely rugged mountains and abrupt, deep cañons, and the dense growth of chemisal found on the hillsides, making it almost impossible to explore the country without hewing the way as you go. And further, the great lack of water in most places where there are any extensive beds of auriferous gravels.

In entering Los Angeles County by railroad from the north, we have on the east side the Mojave Desert, an arid scope of country covering between fifteen and twenty townships in the northeastern part of the county, comprising Townships 8, 7, 6, and part of 5 north, in Ranges 8, 9, 10, 11, 12 west.

This country is broken up in places by low ranges of hills, and covered mostly with a scattering growth of yucca, that was used by an English company as a raw material for the production of paper. For some reason the manufacture did not prove successful, and at present the factory is standing idle. This desert country has been prospected over to some extent, and reports are current of the presence of rich base silver ores, and also copper; further, deposits of clay and gypsum have been found a few miles back of Alpine, one of the stations on the Southern Pacific Railroad. The prospecting and working of these metalliferous veins is accompanied with so much hardship and expense, on account of the scarcity of wood and water and feed, that the mines have never been developed sufficiently to permit of any decided opinion being formed as to their true value.

On the western side of the railroad is Antelope Valley, which extends over to the Coast Range Mountains, coming in from Ventura and Kern, with a course north 60 degrees west and south 60 degrees east. This direction appears to be the line of upheaval which marks the northeast limit of the Coast Range along the line of the desert.

After leaving the desert and crossing the summit of the range, the road decends into the Soledad Pass and Cañon in a westerly direction, where Acton is located—a station on the Southern Pacific Railroad, and a distributing point for one of the few paying quartz mining districts in the county. The aneroid showed an elevation of two thousand two hundred feet.

CEDAR MINING DISTRICT.

The district known as the Cedar Mining District includes an area of about twelve miles square, comprising Township 5 north, Range 13 west; Township 4 north, Range 13 west, and Sections 5, 6, 7, 8, 17, 18, 19, 20, 29, 30, 31, 32, Township 4 north, Range 12 west; Sections 5, 6, 7, 8, 17, 18, 19, 20, 29, 30, 31, 32, Township 5 north, Range 12 west; Sections 29, 30, 31, 32, Township 6 north, Range 12 west; Sections 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, Township 6 north, Range 13 west; Sections 25, 26, 35, 36, Township 6 north, Range 14 west; Sections 1, 2, 11, 12, 13, 14, 23, 24, 25, 26, 35, 36, Township 5 north, Range 14 west; Sections 1, 2, 11, 12, 13, 14, 23, 24, 25, 26, 35, 36, Township 4 north, Range 14 west, of S. B. M. The principal mines in this district at the present time are the following:

Red Rover Mine.

This is in Section 23, Township 5 north, Range 13 west, at an elevation of three thousand three hundred feet, about three miles north from Acton. The vein strikes north 63 degrees west, and dips to the south about 82 degrees, with an average width of three feet. The walls, which are very good, are syenite for the hanging and slate for the foot wall.

The length of the ore shoot is given at two hundred and sixty feet. The mine is opened by both tunnel and shaft; the former is one hundred and forty feet in length and attains a vertical depth of fifty feet. The shaft is an incline about two hundred and eighteen feet deep.

The company use Hercules powder No. 1, and it requires about one pound of powder to every four tons of rock broken. The average cost of mining, per ton of ore, is from $2 50 to $3. The cost of tunneling, per foot of running tunnel, was $1 50 near the surface; now it amounts to from $4 to $5. The timbers cost laid down at the mine about $30 per thousand. They have to be shipped by rail from San Francisco or Los Angeles. The ore is gold quartz, free milling; it is conveyed to the mill on a tramway four hundred feet long.

The company has a ten-stamp mill with Dodge rockbreaker, a forty-horse power horizontal boiler and a twenty-horse power engine. The stamps weigh seven hundred and fifty pounds; they drop six and a half to seven inches, with ninety drops per minute. They have a capacity of twenty-four tons per twenty-four hours. The shoes and dies are steel and are the first set used. Up to date they have crushed one thousand two hundred and seventy tons, or one hundred and twenty-seven tons to the stamp; they will soon require changing, however. The screens used are No. 8 quarter inch, diagonal slot-punched, Russian iron; screens sixteen by forty-eight inches inside of frame, and placed vertical. The aprons are thirty-six to fifty-six inches, two to each battery. The sluices are fifteen inches wide and have a silver plate the full width of the sluice and twenty feet long, with an inclination of one and a half inches to the foot. They have two of the improved Hendy self-feeders, attached to the battery frame. The amount of gold saved is given at 80 per cent, of which about two thirds are retained in the mortar. The mortar contains two silver plates, the front one six inches by forty-eight inches, the back ten inches by forty-eight inches. The loss of quicksilver per ton of ore worked is about one pound to twenty-five tons of ore crushed.

There were at the time of my visit twelve men employed in the mine. This number since then has been largely increased. In the mill three men were at work, and three on the outside. Men in the mine were paid $3 per day; in the mill, $3 60, for fifteen hours work; outside men get $2 25. The mill consumes two and one half cords of wood per day, which costs $4 50 to $5 per cord; it is oak, juniper, and manzanita. The hoisting from a two hundred-foot shaft is being performed by a Baker whim, but a steam hoist will be erected in the near future.

The company experiences a drawback with the water that is at their disposal. They pipe their water through three miles of two-inch pipe into a reservoir, and then, after using it, they have to pump the water over into a tank above the mill after it has settled. This requires all the tailings from the mill to be shoveled over, and even then for a part of the season they can only run the mill for fifteen hours per day for lack of water. It is expected that this trouble caused by the lack of water will be got rid of on sinking the main working shaft to a depth of five hundred feet, which will take place very shortly. This company controls four full claims, known as the Red Rover, the John Logan, Earl, and Topeka. The Red Rover is the only one being worked at present. In the mine there are about two thousand tons of ore in sight, which will average about $10 per ton.

Altitude	3,000 feet.
Length of ore shoot	260 feet.
Length of ore shaft on incline	218 feet.
Depth of ore shaft vertically	About 200 feet.
Vertical depth reached in mine	200 feet.
Character of hanging wall	Syenite.
Character of foot wall	Slate.
Kind of powder used	Hercules No. 1.
Quantity of powder used	About 4 pounds per day.
Cost of mining	$2 50 to $3 per ton.
Cost of tunnel	$1 50 per foot.
Cost of shaft	$8 per foot.
Number of feet timbered	All of shaft (218 feet).
Kind of timber	Pine, square, 6x8 inches.
Cost of timber	$24 per M.
Length of ditch built	3 miles (2-inch pipe).
Character of ore	Auriferous quartz.
Character of works	Steam stamp mill.
Number of stamps	10.
Weight of stamps	750 pounds.
Drop of stamps	6½ to 7 inches.
Drops	90 per minute.
Duty of stamp	2½ tons in twenty-four hours.
Kind of shoes and dies	Steel.
Size and character of screens	No. 8, slot cut.
Dimensions of apron	36x48 inches (two to each battery).
Width of sluice	15 inches.
Length of sluice	20 feet.
Kind of feeder	Hendy.
Character of ore	Free milling.
Percentage of gold saved in battery	50.
Percentage of gold saved on plates	30.
Cost of milling	$2 per ton.
Number of men in mill	3.
Number of men in mine	12.
Total number employed	18.
Average wages in mine	$3 per day.
Average wages in mill	$3 60 per day (fifteen hours).
Average wages paid outside work	$2 25 per day.
Wood used per day	2½ cords in twenty-four hours.
Cost of wood	$4 50 to $5 per cord.

New York Mine.

This mine was relocated May 15, 1889. Years ago it was worked and is said to have averaged $30 a ton. It is situated about three miles northwest of Acton. The vein courses northeast and southwest, and dips to the north about 75 degrees; it has an average width of four feet. It is opened out by several tunnels; the principal working tunnel is about eight hundred feet long, and reaches a vertical depth of three hundred and twenty feet. Below the level of this tunnel is an incline shaft one hundred feet deep. The walls are syenite, with a casing of chloritic slate. They use about fifty pounds of Giant powder No. 1 and No. 2 per month, and the cost of mining they estimate at $3 25 per ton of ore. In running the tunnel they passed through porphyry, syenite, and slate. In this mine they use Oregon pine for timbering, which costs them 4 cents per foot laid down at the mine. There is some timber about twenty miles from the mine.

The mill is about two miles from the mine; the ore is hauled by the owner at a cost of 50 cents per ton. The ore is similiar to the Red Rover; it is crushed in a five-stamp steam mill and amalgamated in the battery and on plates. The stamps weigh seven hundred and fifty pounds, drop six inches, and make ninety drops per minute; they have a duty of two and two fifths tons per stamp. The shoes and dies are of white iron, and cost 5¾ cents per pound laid down at the mine. The shoes and dies have crushed four hundred and fifty tons. In this mill they use patent brass-wire screens, No. 55 to 60. The apron is four feet long, and there are twelve feet of sluices with copper plates one foot wide and set at an inclination of about two inches to the foot. The feeder is home-made. They claim to save about 50 per cent on the plates and 50 per cent in the battery, and the loss of quicksilver is about one pound to every ten tons of ore. A Triumph concentrator has been bought, but has not been put in operation yet.

The number of men usually employed at the mine is sixteen, but at the present time they are only doing some prospect work, so that there are only three men at work. The mill employs four men, and one man works on the outside. The average wages are $3 for miners, $2 50 for mill men, and $1 50 for outside work. The wood costs, delivered, $5 per cord, juniper and oak, and the mill consumes two and one half cords per day. Like the Red Rover Mine, the water supply is a weak point in the plant. It has cost the present owner, Mr. O'Riley, $3,500 to obtain the necessary water, four miner's inches under a six-inch pressure, and it has cost $2,000 to lay four thousand two hundred feet of two-inch pipe to bring the water to the mill.

Altitude	About 3,000 feet.
Length of ore shoot	500 feet.
Length of ore shaft on incline	100 feet.
Depth of ore shaft vertically	About 87 feet.
Character of hanging wall	Slate.
Character of foot wall	Syenite.
Kind of powder used	Giant No. 1 and No. 2.
Quantity of powder used	At present, 50 pounds; with full force, 200 pounds per month.
Cost of mining	$3 25 per ton.
Cost of tunnel	$6 per foot.
Cost of shaft	$8 per foot.
Number of feet timbered	No record; the amount small.
Kind of timber	Pine.
Cost of timber	4 cents per foot.
Length of road built	Two miles.
Length of ditch built	4,200 feet of 2-inch pipe line.
Cost of transport of ore	50 cents per ton.
Character of ore	Quartz, with free gold and a small percentage of iron sulphides.
Character of works	5-stamp steam mill.
Number of stamps	5.
Weight of stamps	750 pounds.
Drop of stamps	6 inches.
Drops	90 per minute.
Duty of stamps	2⅖ tons per stamp in twenty-four hours.
Kind of shoes and dies	White iron.

Size and character of screens	Patent brass wire from 55 to 60 meshes.
Water used in battery	¾ inch.
Dimensions of apron	4 feet.
Width of sluice	12 inches.
Length of sluice	12 feet.
Kind of feeder	Home-made.
Kind of concentrator	Triumph.
Percentage of gold saved in battery	50.
Percentage of gold saved on plates	50.
Cost of milling	About $2 per ton.
Number of men in mill	4.
Number of men in mine	3.
Total number employed	8.
Average wages in mine	$3 per day.
Average wages in mill	$2 50 per day.
Average wages paid outside work	$1 50 per day.
Wood used	2½ cords per day.
Cost of wood	$5 per cord.
Quantity of water used in milling	¾ to 1 inch.

No ore is being crushed at present, as the mine is being prospected to open out a body of quartz supposed to be below the present stopes. At the present depth of working the quartz is of a low grade, not over $7 per ton. The quartz seems to form in swells, and then on a short distance to spread out into a number of feeders penetrating both walls, the walls at such times showing a mineralized condition, containing bunches of iron sulphides, but unaccompanied by gold. The present property consists of three full claims. Near the surface the vein seems to have run in three feeders, averaging about one foot each, and being about two feet apart. Two of these were of good grade, and could be distinguished readily by showing a rust stain in the quartz. The third was of a lower grade. On following them down they all united and formed a body of quartz of from five and a half to seven feet thick. At a depth of about one hundred and twenty feet the vein again consists of a number of seams, none of them over eight inches in width. The gold is of a coarse order, easily amalgamated, and is valued at from $14 to $15 per ounce.

All the quartz in these two mines is of a glassy nature, with occasional streaks of a greenish cast running through it, not copper stain, and showing splashes of iron pyrites. Streaks of calcite are met with in the walls of the vein at no great distance from the quartz. The whole country around here seems to have been mineralized through porphyry dikes that crop out in different places, rather prominently in a northwest and southeast course. A great drawback to these properties is the lack of abundance of water.

Between Acton and the next station below, Ravenna, in the same mining district, are a group of copper mines that have had considerable money and labor expended on them, but on account of the present condition of the copper market are lying idle.

The Emma Consolidated Mining Company.

This property consists of the following ledges: The Emma ledge, four feet wide, ranging to the northeast and southwest, and dipping to the east very slightly, containing silver and copper in quartz. A shaft has been sunk to a depth of seventy-five feet, and a tunnel run in five hundred feet, but will have to be continued another one hundred feet to strike the vein, which it will do at a vertical depth of four hundred feet. The tunnel is six by eight feet with an air shaft. Wood and water are plenty in the vicinity of the mine. The Bullion is situated on the same hill, and in close proximity to the Emma. It runs parallel with the Emma, and dips towards it. The ledge can be seen in a deep cutting with a width of eight feet. The ore carries gold, silver, and copper.

The Pacific is the extension of the Bullion on the same vein. The London crosses the other two veins, running almost east and west. They are four full claims, and were located in 1888, but had been worked years ago by a French syndicate. The Pacific has a shaft forty feet deep, showing a well defined six-foot ledge containing gold, silver, and copper ores. The London ledge is about three feet wide, containing copper and silver. It has an incline shaft seventy-five feet deep, and a tunnel one hundred feet long, which will ultimately tap the ledge at a depth of about three hundred feet. The ores are carbonates and sulphides in quartz; the country rock is granite. The value of the Bullion and Pacific ores, from tests made, is $4 in gold and $15 in silver.

The Emma vein contains 15 per cent copper and 15 ounces silver. The Bullion and Pacific dip to the west; the Emma to the east, and the London to the south. About two miles and one half south of Acton, close to the railroad and at an altitude of two thousand two hundred feet, is a shaft that was sunk to a depth of thirty-five or forty feet on a strong vein of copper and silver ore; but at that depth the parties sinking encountered so much water that they abandoned the property. From Acton, down the road to South Side and Lang's Station, the metamorphic rocks are prominent, granitic rocks with dioritic dikes, then again decomposed greenstones, and breccia of green and red porphyry.

A little beyond Ravenna, on Section 15, Township 4 north, Range 13 west, not far from the road, is a stratum of magnesia, pitching to the west into the hill at an angle of 30 degrees, and back of that a very bold, pronounced range of red sandstone and conglomerate, extending quite a distance, with a northwesterly trend, and dipping to the west at an angle of about 30 degrees. Underlying this is a heavy body of granitic rock, with dikes of greenstone cutting through. After passing down the road from South Side we find issuing from the metamorphic rock several sulphur springs, some of which are being used for medicinal purposes. Below and north of Lang's Station about two miles is a large deposit of gypsum, nearly eight feet wide, almost perpendicular, in Section 30, Township 5 north, Range 14 west, S. B. M. After passing Lang's Station the cañon widens out, the main metamorphic range stands back, and some very fine exposures of clays and sandstones and shales show themselves, dipping but little.

Mount Gleason Mines.

About four miles east and south of Acton, on the opposite side of the main cañon, rises the Gleason Mountain to an altitude of six thousand five hundred feet. It is a prominent spur of the main range, occupying Sections 25, 26, 35, 36, Township 4 north, Range 13 west, S. B. M. It is a granitic structure with micaceous clay slates. On this mountain there are several quartz veins coursing northwest and southeast, and dipping to the northeast at an angle of about 80 degrees, and on these considerable work is being performed at the present time. The mountain is partly timbered and fairly well watered. A good mountain road leads half way up the mountain; from there mules have to be used for hauling.

The principal mines are the Padre Mine, the Mount Gleason Gold Mine, the Kelly Bros.' Mine, the Peerless, and a group of claims known as the Casa Grande Mines. The latter claims consist of the Gold Bullion, the Log Cabin, the Veteran, the Golden Rule, and the Old Town. These claims are contiguous to one another, being extensions of one vein, with the exception of the Gold Bullion. The vein courses north 35 degrees west, and forms the apex of one of the ridges running from the main spur down about one thousand five hundred feet into a cañon that has its drainage into the Tujunga Cañon. The vein averages something over two feet in width. The quartz from the surface shows considerable rust stain, and is honeycombed. A mill test of this ore gave $12 per ton in gold. Another vein coming down the highest ridge has a course of north 50 degrees west. A third vein coursing similarly shows at present the most exposures and workings. Of these mines the oldest is the Padre Mine, with a shaft eighty-one feet deep, situated one hundred feet east of location notice, with a three-foot vein in the bottom of the shaft. The ore from this mine pays from $8 to $12 per ton by common mill process. One hundred feet east of this shaft is another shaft forty feet deep, with a five-foot vein paying $16 per ton; also a drift eighteen feet long. This vein shows very bold, prominent croppings. The immediate contact walls with the quartz are micaceous clay schist, but the country rock is granitic. A peculiarity in the contact of the walls is, instead of having a clay gouge solely, there is a distinct division caused by an accumulation of particles of mica to the thickness of half an inch in places.

Adjoining the Padre Mine, which was not being worked the day I was there, is the Mount Gleason Gold Mining and Milling Company's property. They have a tunnel one hundred and forty-five feet long, eighty feet of which is run on the course of the vein, exposing a vein from three feet wide at the commencement to eight feet wide at the end of the tunnel, which is eighty feet perpendicular beneath the surface. This company has about two hundred tons of ore on the dump that they claim will average about $16 per ton by actual working test. The quartz is honeycombed, showing native sulphur in some of the cavities; also free gold in a finely powdered condition. At the present time, a five-stamp steam mill is in course of erection. This company claims two locations—the *Last Chance* and the *Eagle*—one of which is in dispute. The next extension to the southeast is the Kelly Bros.' claim. They have three tunnels—one fifteen feet, one forty-seven feet, and the third sixty feet in length—running in on the vein on different sides of the cañon that the vein crosses over.

In this claim the vein mass shows a very pronounced sulphide character, pieces of solid iron sulphurets being found as large as a man's head. This company is putting up a two-stamp steam mill, and have quite a large amount of ore out ready to crush, but the ore looks rather unsuitable for a simple battery amalgamation process. At the east end of this claim, a cut, six feet long, five feet deep, exposes the ledge three feet wide. The east extension of this claim is the Peerless, lately taken up, and not showing any great development, a short drift having been run to the vein and some surface exposures made. The drift is twenty feet long, and shows the ledge to be two feet wide. At the west end of the claim, the vein appears to be broken up; at the east end, it shows solid, and about one and one half feet wide.

Passing up the Soledad Cañon about four miles we find the mouth of the Aliso Cañon, which winds around to the east of the base of Mount Gleason, through a mesa composed of metamorphic drift and wash, and which has been cut down and exposed in places to the depth of fifty feet, at the same time laying bare, in places, the granitic flanks of the spurs of the main ridge. All of this wash is auriferous, but not in sufficient amount to pay with the amount of water on hand. Finally, after attaining an altitude of four thousand six hundred feet, we reach the top of a narrow divide separating the watersheds of Aliso and Tujunga Cañons. The formation continues unbroken granitic, with large crystals of feldspar and occasional dikes of diorite.

The road now descends into the North Fork of the Tujunga a distance of five or six miles, when we once more meet with evidences of quartz mining. A tunnel leads into the hillside at the road level a distance of about one hundred and fifty feet; the back end being filled with water, we could not ascertain the length. About forty feet from the entrance is an incline shaft about twenty-five feet deep, but we could not find any vein. On the opposite side of the road were three steam arrastras, but the engine had been removed and the whole bore a deserted appearance.

TUJUNGA MINING DISTRICT.

About seven miles from the Divide we reach the Tujunga Mining District, and find the following mines:

Josephine Mine.

The Josephine Mine, at an altitude of four thousand feet, has one tunnel about one hundred and fifty feet long, about sixty feet under the surface vertically, showing a three-foot vein coursing north 10 degrees east and south 10 degrees west, dipping almost perpendicular. Below this is another tunnel between three and four hundred feet long, with the vein four feet wide; here the dip has changed to about 50 degrees to the east. Between the lower tunnel and the surface the ground is nearly all stoped out. In connection with this mine is a small four-stamp steam mill and a five-foot Huntington centrifugal mill. The stamps weigh four hundred and fifty pounds; the duty of the mill is about half a ton to the stamp. Neither mine nor mill was running, but the mill was being fixed up to make some working tests on ores from neighboring mines.

Parties living in this camp claim that the ore cannot be successfully worked here; that ore sent to San Francisco gave high returns in gold, while the same ore worked in the mill here hardly yielded expenses. As the ore is for the most part a honeycombed quartz, with iron sulphides, and yields its gold readily in the horn spoon, and the gold is readily absorbed when brought in contact with quicksilver, the trouble must be in the manipulating. The idea was that the water contained some substance deleterious to amalgamation, but as far as taste or smell could discern, I failed to notice anything unusual in the water; there was certainly no evidence of oil.

Besides the Josephine, there are the Tujunga claim, the London, the Hope, which are all extensions of the same vein, and have more or less surface work done on them, in the shape of uncovering the vein along its outcrop. In close proximity to this claim is the Lottie, at an altitude of four thousand three hundred feet. This ledge strikes 32 degrees east of north and west of south, and dips to the west at an angle of 50 degrees.

The vein averages about one foot in width and shows, near the surface, considerable decomposed quartz that prospects very high. An incline shaft is down on the vein about forty feet, and a small side drift is run from it about twelve feet. A little beyond the incline is a drift about sixty feet long, which shows the vein in the end about one foot wide; besides this, there are several small cuts and prospect holes along the line of the vein.

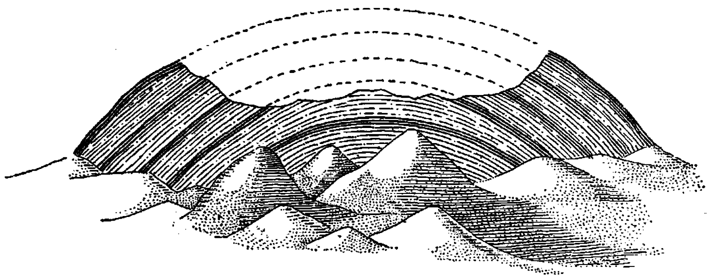
The extension of this vein to the north belongs to a group of veins owned by Los Angeles parties, the principal claim of which is the Pacific, where several men are at work. This is on the highest part of this spur, at an elevation of five thousand nine hundred feet. The work done here consists of a sixty-foot drift, showing in the end a two-foot vein, striking east and west, dipping 82 degrees to the north, and stoped from the tunnel level to the surface, a distance of thirty feet. At the end of the drift is a perpendicular shaft, fifty feet deep, eight by five feet from the bottom. A drift has been started, which is in about twenty feet, and shows a vein two feet wide, between walls, with about ten inches of quartz.

The country rock is granite with large crystals of a bluish feldspar. They are taking out ore here for a test run to be made in the mill belonging to the Josephine claim. Across a gulch from here, to the east, on another spur, a claim was taken up called the Dundee, and two shafts sunk and a drift run, but without any results. All of these mines show the same quality of quartz, honeycombed, rust-stained near the surface, white and glassy, with undecomposed iron sulphides below. Another claim belonging in this group is the Cable, which has a tunnel forty feet long, striking a ledge bearing north 10 degrees west, and dipping 80 degrees east. The end of the tunnel is about sixty feet underground. One man was at work here. Near the mouth of the tunnel is an incline shaft sunk on the vein to a depth of twenty feet, showing four feet between walls.

Passing northwest from the Tujunga camp over a trail, about one mile distant, at an altitude of four thousand six hundred feet, is "the Moose claim," with a foot wide vein coursing 35 degrees northwest and southeast, and dipping to the east under an angle of 45 degrees. The walls are granite. But little work has been done. In passing down the Tujunga Cañon, veins of specular iron can be seen; also, about seven miles from the mines, a granite with extremely coarse flakes of mica, some of them being one and one half inches square. In the main Tujunga Cañon, two or three parties of Americans are working with dry washers, with varying success.

After reaching Kent's Station, where the Soledad Cañon broadens, we have in the foreground a range of low-lying hills of clay and sandstones and gravel, showing some very distinct exposures; one in especial shows the distinct stratification of different colored clays, and then a later denudation of the top with a redepositing at a short distance in front. Back of these the main range on the south side presents several spurs toward the cañon that are quartz bearing; they are distinguished in name by the cañons lying between them, and which have been called the Blacksand Cañon, the Bear Cañon, and the Arrastra Cañon. Where the first two of these cañons debouch into the flat, some prospectors found and showed me some pieces of float telluride of gold, which we tested in an assay office in Newhall afterwards, but up to the present time I have not heard of its having been found in place. These cañons have a general southeast and northwest direction, and are extremely narrow and rugged. The ranges that divide them consist of granitic rocks, porphyries, and micaceous clay schists; but they are so completely covered with a heavy growth of chemisal as to make explorations extremely tedious.

Nº 1



As in all the cañons of this country, the small streams found in them become raging torrents for a short time after every rain, and bring large quantities of debris off the main ranges, accumulating the wash at the mouth and in the cañon. Most of this wash is auriferous, but not sufficiently so to encourage any one with the small amount of water on hand to work it.

The first quartz vein we encounter is near the mouth of Bear Cañon. It has a strike of 16 degrees east of north, dipping to the west about 53 degrees, with a width of about eighteen inches, and with clay-slate walls. It is known as the Providence Ledge; has had a little work done on it, but is at present abandoned. About two miles further up the creek there is another quartz vein crossing the range between Arrastra Cañon and Bear Cañon, and continuing through the range that divides the latter from the Blacksand Cañon, with an east southeast and west northwest strike, and dipping to the south. Here a mining district has been formed in Sections 35 and 36, Township 4 north, Range 15 west, S. B. M., known as the St. George Mining District, recorder Mr. G. Rehbert, who is also the owner of the principal claim, as far as developments are concerned. Through him we obtain the following information:

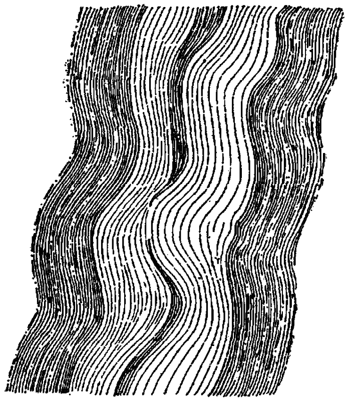
There are at present in the district three claims that are being prospected, while a large portion of the country has been staked off by claimants, who merely do assessment work and wait for somebody to buy them out. The three main prospects are known as the Star of the East, the Star of the West, and the Evening Star. All these claims are situated on the same vein, coursing east southeast and west northwest, cutting through the dividing ridges at an acute angle. The vein dips to the south at an angle of about 45 degrees, and has an average width of twenty inches. The walls are clay-slate and porphyry. The ore will average about $16 per ton. The Star of the West employs part of the season two men at $2 50 per day. The developments consist of two tunnels running on the vein from Bear Cañon, one on each side of the cañon, at an altitude of two thousand and twenty feet; these are twenty-five and twenty feet long, respectively. The ore has been worked in a horse arrastra eight feet in diameter, situated about half a mile above the tunnels in the cañon, and yields on an average about $25 per ton. The gold is very coarse, some pieces found being worth $1 25. This claim controls a water-right at the head of the cañon, with about four miner's inches of water under a six-inch head.

The Star of the East lies mostly in Blacksand Cañon. The sides of the cañon are extremely precipitous and covered with chemisal, making prospecting extremely difficult. Other quartz veins are said to exist higher up, as float is found among the debris washed from the main range which carries a large percentage of silver. A very great amount of the wash in the cañon consists of a micaceous ironstone. A very interesting geological feature is seen on an exposure of the quartz vein in Bear Cañon, which would seem to clearly demonstrate its metamorphic origin; the vein matter shows here not only a banded or stratified face, but these strata show that they have evidently been distorted.

In passing from here back to Kent Station, and from thence to Newhall, a person cannot help being struck with the very large bodies of wash and

FIG. 2.

Quartz Exposure in Bear Canon



gravel that present themselves, all auriferous to some extent, but which lack the necessary amount of water for their profitable conversion.

Newhall, a small town and station on the Southern Pacific Railroad, is the shipping point for the Pacific Oil Company's wells around Pico Cañon and adjacent points. It is about twenty miles north of Los Angeles and immediately north of the San Fernando Range. It has two creeks in close proximity that empty into the Santa Clara through Pico Creek, but are nothing more than dry river-beds through the greater part of the season.

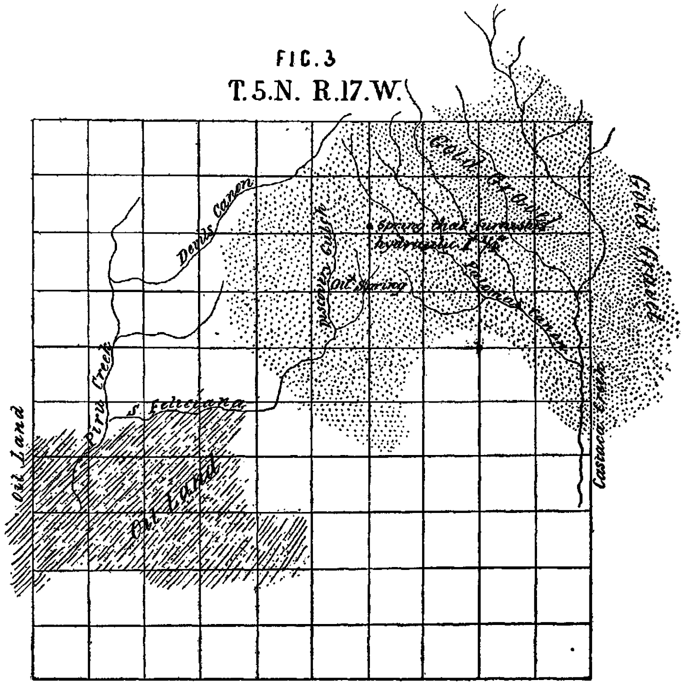
Running northwest and southeast are a low range of hills of tertiary, sedimentary formation, between which the Placerito winds, forming a cañon, in which, in some places, gravel mining has been carried on by hydraulic process, and also by drift and with the rocker. These hills are entirely composed of gravels, clays, shales, sandstones, dipping to the north at a very small angle. On the bars in the cañon there are spots that yield an appreciable amount of washed gold, the source of which seems to lie beyond the head of Placerito Cañon, in the metamorphic rocks of the main San Fernando Range. A Los Angeles company has lately bought an extent of placer ground here, and are trying to hydraulic it with water raised out of a thirty-foot shaft by steam power. The ground is said to be rich. It was bought for $15,000. About four miles up the cañon the creek forks. The main fork, on the south side, enters between metamorphic rocks and meanders in a southeasterly direction. Some good exposures can be observed here.

The bluffs show a granitic, or more correctly, a syenitic and gneissoid structure. They rise to an elevation of one thousand seven hundred feet above the sea. Their original sedimentary and plastic condition can be very distinctly observed, showing an arrangement of the mica particles that gives a very perfect cleavage, also showing remains of foldings and contortions, and from that on through to rock, where all structural formation is obliterated. Bearing more to the east, about four miles from the forks, we find a vein of limestone, white and crystalline, between two varieties of syenite, the one of which shows very large, distinct crystals of hornblende; the other approaches nearer the character of a true granite. The limestone trends to the north 60 degrees west; it is in Section 5, Township 3 north, Range 15 west, S. B. M., and dips almost perpendicular. All along this part of the cañon evidences of placer work are seen, and on inquiry we found that the Chinese work here during the wet season. About one mile further up the cañon from the limestone ledge we reach the head of the main Placerito Cañon; it runs out into several small cañons reaching up onto the main range, and among the low hills of sand and gravel deposited on the flank of the main range, and furnishing the material for the present work of denudation which is progressing here so visibly.

On the main range between the head of Placerito Cañon and Bear Cañon are several graphite veins, but not of a grade to pay for working them.

AURIFEROUS GRAVELS OF CASTACA, PALAMOS, AND SAN FELICIANA CAÑONS.

FIG. 3



Going in a northeasterly direction from Newhall, at the crossing of the Santa Clara River, we enter the mouth of Castaca Cañon, with a creek of the same name. Following this creek about six miles, we reach some extensive deposits of auriferous gravel, where the Palamos Creek enters into Castaca Creek from the west side (Fig. 3). Going up through Palamos Creek into San Feliciana Cañon, we find some parties working these gravels, with the help of Chinese, in what is known as the east part of Palamos Mining District. They worked with a small hydraulic, collecting water from a spring yielding one and one fourth miner's inches. This is gathered in a reservoir that permits of the use of the pipe, through a two-inch nozzle, for two hours and a half a day. The altitude of these diggings is two thousand four hundred feet; the area, roughly estimated, is eight miles by four miles in extent, but the whole of it is considerably cut up by gulches and cañons. The gold is in the nature of sheet gold. The bedrock of this cañon is mostly conglomerate, though clay-slates and shales are also to be found; in fact, the gravel here overlies the sedimentary formations, in which the oil measures are found.

This gravel deposit furnishes some interesting studies as to its formation. Fossil remains of deer and mammoth have been found the past season, consisting of the thigh bone of a mammoth, also a tusk. The former is now in the possession of a gentleman in Los Angeles; part of the joint was forwarded to the Bureau. The tusk fell to pieces as soon as it was exposed to the air. Besides this, prints of bird tracks were found in the bedrock, evidently waders. These had been destroyed, as of no value, in the course of picking up the bedrock. If we consider these facts in connection with the very irregular, uneven bedrock, it would seem to point to the fact that the water was not confined to the narrow bed of a stream in which this gravel was deposited, but spread out, with little current and shallow banks, that permitted a heavy growth of water grasses, the home of numerous insects and worms, thus attracting both the animals and birds, while the marine shells in the near surroundings would point to an inlet of the sea or a bayou of brackish water.

The shape of the gold found would also be more likely to be produced by the scouring motion of the tides than by the rolling motion of a running stream. Furthermore the richest part of the gravel is not exclusively on the bedrock, but in streaks in the gravel, that can be plainly distinguished by a heavy rust action. These lie in places considerably above the bedrock, and sometimes above one another. The accounts of the yield of this gravel, which has been worked years ago, are very conflicting. The Mexicans formerly are said to have taken out large sums, which their extensive workings in some places would seem to corroborate. The present workers on the ground put the yield, per square yard, rather low, but even at their figures if, as is thought possible, water could be brought from the Piru Creek, all this immense scope of gravel could be made to pay something handsome over expenses. The height of the gravel is hard to estimate, it having been cut out so much; it has been given as averaging ninety feet, but I consider that rather high. Between these gravel hills and the Castaca Cañon is a range of hills composed mostly of sandstones and cemented conglomerates, crowned beyond by a range of metamorphic rocks, which show some quartz veins that have been prospected by tunnel, but are now entirely abandoned.

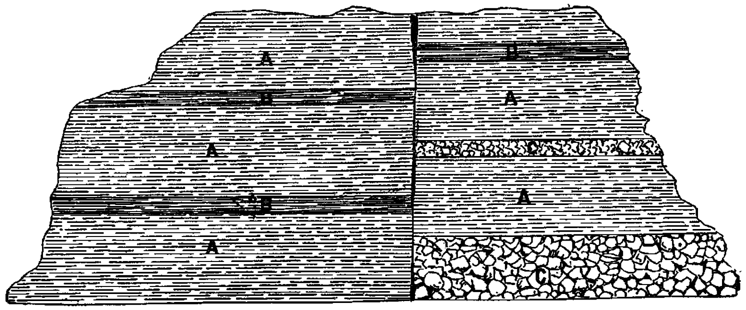
In passing up Palamos Creek into San Feliciana Cañon, I noticed a deposit of very fine, white, quartz sand, that seemed to be suitable for glass-making purposes. At the head of Spring Cañon, near Palamos Cañon, float quartz is said to have been found of great richness, but no explorations have been made.

Crossing Castaca Cañon, opposite the mouth of Palamos, and taking up over the hills in a northeasterly direction, we again find a large area of auriferous gravel on the other side of Charles Cañon, that has been taken up by a New York company. Their ground comprises an area of nine thousand acres, extending up both sides of the Cañon El Dura. To work this ground with hydraulic process—the only way it can be advantageously disposed of—requires the bringing in of a ditch from Elizabeth Lakes, a distance of four miles, by which they will obtain a large fall. The gravel differs from the San Feliciana in that it is harder—more cemented with iron. The bedrock, where seen, is sandstone; the gravel is not as smoothly washed as the other. A good deal of work has been done in these cañons by Mexicans and Americans with the pan and rocker. The gravel is about six or eight feet thick in the cañons. The gold is not so coarse as in the San Feliciana Cañon. In the Charles Cañon evidences of bituminous sandstone are visible, but not to any extent.

A third company has been organized under the name of the Nevada Gold Mining Company, who claim three thousand five hundred acres between Elizabeth Lake and the Castaca Junction. They hold a water right of one thousand miner's inches out of the Castaca Creek.

About four miles up Castaca Creek from the entrance of Palamos the cañon is bounded on both sides by shales and sandstones dipping at an angle of about 30 or 35 degrees, and interstratified with very thin strata of carbonaceous matter almost entirely of the nature of charcoal, being in places quite feathery. Here some parties have put down two shafts, one on each side of the cañon, nearly one hundred feet deep, with the idea of striking coal in paying quantities; both shafts encountered so much water that operations had to cease until pumping machinery could be obtained. In the hills back of the cañon on the northeast side there is a large deposit of calcareous sandstone, with large oyster shells embedded; this sandstone is in places interstratified with thin layers of gypsum. The main Castaca Cañon here is about two hundred yards wide. The ranges on both sides, rising about four hundred feet above the cañon, are regularly stratified, the general course being northwest and southeast, and dipping to the west. Continuing up the cañon a distance of five miles we have a very distinct exposure of the formation, sandstones, shales, and conglomerates, dipping conformably, showing in some parts local disturbances, and one very distinct faulting, as shown in the accompanying sketch:

FIG. 4.



A *Sandstone* B *Shale*
C *Conglomerate*

Turning to the east and leaving the cañon, after crossing a divide at an altitude of seven hundred feet, over a precipitous trail, we strike once more the porphyritic and granitic rocks. At first we find a porphyritic dike about three miles wide and six miles long, with a general east and west trend, with granite on the north and sandstone to the south. In this porphyritic belt several quartz veins are found.

The whole ridge is known as Silver Mountain, and constitutes the main part of the mining district of the same name.

SILVER MOUNTAIN MINING DISTRICT.

The principal prospect is known as the Silver Mountain Mine, situated at an altitude of two thousand eight hundred feet, and owned by Colonel

De Freese and Barrett. Two further claims on the same ledge are owned by Messrs. Kelsey & Thomson; their mine is about one hundred feet higher than the first, and yet another one hundred feet of elevation brings us to a third claim; these last two claims are to the northeast of the Silver Mountain Mine.

The Silver Mountain Mine was being worked under a six months' bond. The parties working had just forwarded one thousand pounds of the ore to San Francisco to be worked as a test. I have since heard that the returns were lower than expected—$8 22. The ore is a sulphide (galena and iron pyrites) and the whole thing seems to be more in the nature of an ore pipe. Several openings have been made, both by tunnels and inclines, yet not sufficient to prove the extent of the ore shoot. In the other two locations we found one tunnel one hundred and twenty-five feet in length, but at the time of our visit no work was being done, nor was any one around the place. About a quarter of a mile northeast of here there is a quartz location with three tunnels; the lowest shows a body of sulphide ore, fifteen feet wide, over two hundred and fifty feet vertically beneath the surface, striking southeast and northwest and dipping about 70 degrees to the north.

Returning to the main Castaca Cañon and continuing up the creek three miles further, through sandstones and conglomerates, we reach the mouth of the Little Castaca Creek. This, like the main creek, gives opportunity to study some fine exposures of sandstones and conglomerates. At a distance of two miles beyond the mouth, traveling easterly, we come upon a large belt of limestone several miles long, ranging east of north, west of south, about one hundred yards wide. This limestone is bordered on the north by granite. Some prospecting has been done here and ore said to contain silver found. Specimens found showed iron sulphides.

Parallel with this limestone is a quartz location known as the Great West, striking 15 degrees east of north, dipping 47 degrees to the west, at an altitude of two thousand four hundred feet. The ore is said to assay $28 per ton in silver. In this vein a layer of mountain leather (asbestos) was found next to one wall. Several prospect cuts and tunnels have been started, but no regular mining developments. Where the limestone breaks over the top of the hill fine specimens of aragonite showing the concentric ring formation were found, also specimens of calcite. Overlying the limestone is a calcareous sandstone containing shells, but mostly in a crushed and mutilated condition.

In continuing still further up the main Castaca, the cañon goes by the name of Salt Creek, from the salt pools that are found near its head, filled with salt in a mushy condition. In several places in the cañon and in some of the smaller side cañons the clay slates and shales show a white efflorescence which has a sweetish, puckering taste, presumably alum. About one and a half miles southwest from Newhall, in some low-lying sandstone hills, a Mr. Brophy is mining for coal. He has started an incline drift on one of the larger bituminous strata, on the same dip as the strata have, 25 degrees north. The strike is east and west. This stratum in the end of the drift is thirty-two inches thick, and above it is a layer of thirty inches of fire-clay. The roof is ferruginous sandstone, containing strata of shells in places. Toward the bottom of the drift the carbonaceous matter becomes more compact, assuming in places the appearance of lignite. They say they have had it tested and it contains 72 per cent carbonaceous matter and 26 per cent ash.

As the oil wells of the Pacific Oil Company and the California Star Oil Company have been visited and discussed both by Professor Goodyear, E.M., and Mr. Silver and others, in previous reports of the State Mining Bureau, I will merely refer to them, to note that a very interesting experiment has been in course of progress during the past season. At Well No. 19 of the Star Oil Company they are putting down a well for the first time in California with the diamond drill. At the time of my visit they had obtained a depth of over four hundred feet (at the present writing they are down eight hundred feet, and will soon commence pumping). As compared with the old style of drilling, the advantage they expect to derive lies in being able to tell exactly the nature, thickness, and inclination of the strata they pass through. Another advantage is gained by always having a perfectly straight hole, thus saving the time required sometimes in the other method in rimming out a crooked hole.

As the tool does not get stuck in the hole, there is no time spent fishing for lost drills. The speed in putting the hole down is not as great as with the old style, and in soft, putty-like ground it does not seem to work at all, as the diamonds become clogged, shutting off the water. Up to the present time they have averaged about a foot an hour when drilling, a much slower progress than is made in the old style of drilling. The principal objection among practical oil men to the diamond drill is that it necessitates the constant presence of water in the hole, which presses back the oil. During my presence at Well No. 19 some interesting specimens of the core were obtained, containing very perfect shells, in the oil-sand strata. Since last year the company has five new wells down. The production is about the same—in the neighborhood of four hundred barrels per day. They find that their productive ground extends a good deal further east than they had expected, and they have just erected the plant to sink a well on this new ground, which will be designated as Elsmere No. 1.

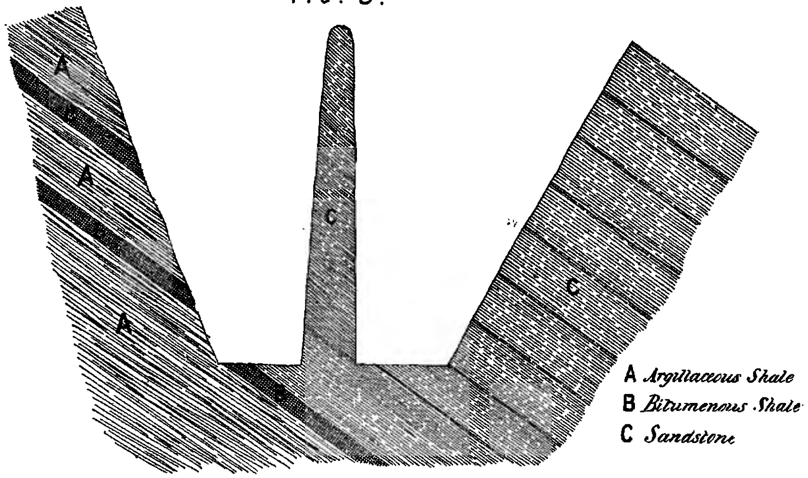
The California production of oil is a matter of vast importance to the State, and is yet only in its infancy. A thorough study of the oil measures as to their thickness, regularity, and occurrence would be of great lasting benefit to the County of Los Angeles especially, as it is by far its most important mineral production. This is the more to be desired, as the oil measures in Pennsylvania and the Eastern States being different—more simple, in fact—are not a sufficient guide for the complex conditions found on this coast. A special geological map of the oil lands of Southern California, though hard to execute on account of the extreme ruggedness of the country in part, would repay the cost and labor expended on it manifold.

The California production of oil has not reduced the importation of illuminating oils, as up to the present time the eastern oil has been found more fitting for that purpose; but experiments looking in that direction are being all the time made, and some very good samples of illuminating oil have been produced. The main trouble seems to be too large a percentage of the heavy hydrocarbons, causing it to smoke when exposed to drafts. California oils are mostly used for fuel and as lubricants, and in the latter capacity they have almost entirely replaced the importation of foreign oils.

The eastern part of the California Star Oil Company's ground, where they are now starting the Elsmere Well No. 1, can be very thoroughly examined through a small cañon that enters near the San Fernando road about two miles south of Newhall, and which continues to the divide of the San Fernando Range, not far from where Grapevine Cañon heads, on the south side of the range. In the debris of this cañon we meet with granites, argillaceous shales, oil sandstones, bituminous and fossiliferous sandstones, bituminous shales, and asphalts and porphyries. The sandstone bluffs that mostly form the walls of the cañon, are in part heavy-bedded, striking to the north and south and dipping about 58 degrees to the west. In these sandstones, toward the lower strata more especially, we find remains of helix, ostræa, spirifer, and other shells. This sandstone seems to overlie the argillaceous shale, which is traversed by bands of bituminous shale, from which, in numerous places, the bitumen exudes and gathers in pools on the bottom of the cañon.

In several waterholes in the course of the cañon evidences of the presence of oil were distinctly perceptible. The water here was alkaline, and the shale in several places bore a white efflorescence. After passing up the cañon quite a distance it contracts until it is not over six feet wide, and is here divided by a narrow wall of sandstone, as seen in the section in Fig. 5. On both sides of this dividing wall, as also on the left hand wall of the cañon, are, at irregular intervals, about four feet above the bottom of the cañon, nodules of sandstone imbedded, about one or one and a half feet in diameter, looking as if carried up and lodged by a tide. The aneroid showed here an altitude of one thousand four hundred feet. About half a mile beyond this divide we find a large amount of shell remains. The top of all these strata on the main divide is capped over with a very dark limestone.

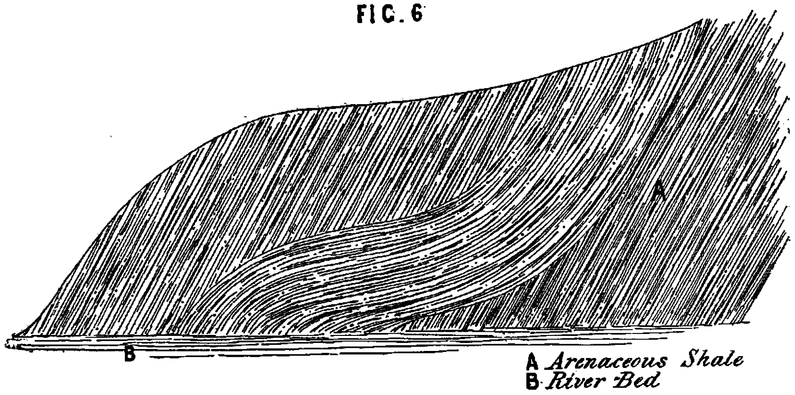
FIG. 5.



LOS ANGELES CITY.

The City of Los Angeles is situated in a valley of the same name, which extends from the ocean back in an easterly direction about thirty miles, gradually sloping up from sea level to an altitude of one thousand five hundred feet. The low-lying hills in the immediate neighborhood of the city are unaltered clay shales and sandstones, striking northeast and southwest, with a dip of about 50 degrees southeast, occasionally interstratified with thin layers of gypsum and lime. Some of the exposures in these bluffs are very distinct and interesting, as the accompanying figure (Fig. 6), taken from a bluff beyond the old depot on the road to Verdugo, shows. In several localities in and about the city, wells for oil and gas have been bored. About nine miles from the town to the north, in what is known as the Rosenkrantz Tract, Section 18, Township 3 south, Range 13 west, S. B. M., gas has been struck in sinking for artesian wells, but in what quantity I failed to ascertain. To the south and west, on some of the low-lying hills, exudations of asphaltum can be seen emerging under the gravel. All the clays which surround and in part underlie the town furnish an excellent material for brickmaking, for which purpose it is largely used, several large brickyards being in active operation

FIG. 6



GRAPHITE

Northeast from Los Angeles, about twelve miles distant in the San Rafael Range of mountains, close to the road in Verdugo Cañon, in Section 4, Township 1 north, Range 13 west, we find a deposit of graphite between walls of micaceous clay schist, coursing north 25 degrees west, and dipping 80 degrees to the west, at an altitude of one thousand eight hundred feet. This vein, where it has been uncovered, shows a width of about twenty feet. The parties who control this property state that they have had it tested, and that it contains between 60 and 70 per cent of carbonaceous matter, with some iron. It is favorably situated for working, being but a short distance from the Glendale and Los Angeles Railroad, to which a siding could be made. A drift of about forty feet in length at the level of the road would crosscut the vein at a depth of fifty or sixty feet, and this is what the owners purpose doing.

Not far from this deposit, in a low range of hills three miles from the main range, at an altitude of eight hundred feet, is an extensive calcite deposit, coursing north 45 degrees east, and dipping 87 degrees east; also, in the near neighborhood, some sulphur springs.

SANTA MONICA

Going from Los Angeles by way of the railroad to Santa Monica, we skirt to the south of the Santa Monica Range, which has a northwest and southeast trend. This range terminates in abrupt bluffs facing the ocean, at an altitude of from seventy-five to one hundred feet, and shows unaltered clays and sandstones overlaid in places with partly cemented gravel, especially around the neighborhood of Arch Rock, which is formed entirely of cemented gravel, partly worn away by the action of the waves.

About four miles up the coast and about one hundred rods up one of the small cañons that discharge on the beach, there are some bituminous shales exposed coursing northwest and southeast and dipping at an angle of about 10 degrees to the east. Here some parties started a tunnel for coal; they have gone in on the pitch of the strata about two hundred feet, but would not give any information as to the result of their labor. Beyond Arch Rock the coast line swings out to the west until it reaches Point Dumas, where there is a large deposit of diatomaceous earth. Large pieces of this rock become detached and fall into the ocean, and are washed across the bay to the neighborhood of San Pedro. Turning to the southeast from Santa Monica and following the beach line, we find the same kind of bluffs coming down to the edge of the water, dipping slightly (about 10 degrees) inland, forming a tableland, over which the road passes. This mesa is indented and cut up by small cañons draining down into the ocean.

Two or three miles before reaching Redondo Beach we find some bluffs of very fine, pure clays of a yellow, brown, and ocher tint, very suitable for mineral paints, for which they have been successfully tested by practical painters. Opposite the coast here is the Island of San Catalina, which belongs under the jurisdiction of Los Angeles County, and of which we will speak later.

SAN GABRIEL.

From Los Angeles to the east, going along the flank of the San Gabriel Range, we come to the cañon and creek of the San Gabriel. The cañon is very tortuous in its course, the banks extremely rugged, showing the effects of heavy denudation on its naked metamorphic rockbound sides. The whole country gives evidence of violent disruptions. Three or four miles up this cañon we find the works of the Victoria Gold and Silver Mining and Milling Company, an English company holding several claims, two of which are patented, in Sections 12 and 13, Township 1 north, Range 10 west.

They have a beautiful little ten-stamp mill arranged for the Boss continuous process, run by two breast wheels. The company has made a large number of excavations, but as the mill had never ran, and we could not find any ore dump, and all parties connected with the works were extremely reticent, we presume the vein or veins must be small, if present at all. The company themselves claim to be still prospecting.

In the same section, but further up the mountain, are the Kelsey and Mint claims, which have been the cause of so much excitement in Los Angeles in the last two or three months, on account of the amount of native silver said to have been found there, and on account of the combination of silver and cobalt ores, similar to ores found formerly in Schneeberg, in Saxony. Nobody was at work there at the time of our visit, and the works were locked up. The following statements are taken from a report that was made on the property by a Mr. Roberts: He states that a fault south of the vein displaces about eight hundred feet of the vein. On the south side of the fault is micaceous sandstone. He gives the dip as 25 degrees to 30 degrees east, the strike north and south, and the width of the vein from four to six feet. On the north side of the fault considerable hornblende is in the rock, inclining it to gneiss, but more massive than schistose. He states it to be a true fissure vein, and gives the following list of minerals as occurring: Native silver, silver glance, chloride of silver accompanied by carbonate of copper, iron oxide, black oxide of manganese; to which he might have added erithrite, cobalt glance, and earthy cobalt.

The gangue, according to the report, consists of baryta, chalcite, and quartz.

Further up the cañon, in Sections 21 and 22, Township 2 north, Range 9 west, S. B. M., parties are working the auriferous gravels that flank the mountain side. They have more resemblance to the pliocene gravels of the northern counties than the auriferous gravels observed in Soledad Cañon, and in Palomas Cañon and its tributaries.

The gold from these gravel deposits is rough, and worth from $16 to $17 per ounce. A good deal of prospecting has been done on the mountain ranges bordering on the San Gabriel Cañon, and we were shown specimens of silver, lead, and silver copper ores, said to have been found on the west branch of these mountains, which, if present in any appreciable quantity, would give a great impetus to the mining business in this section. Following along the flanks of the Sierra Madre, on the southeast side of one of the spurs running down towards Pomona Valley, near Lordsburg, about four miles from the railroad, in Section 26, Township 1 north, Range 9 west, S. B. M., parties have opened a quarry of building stone, at an elevation of one thousand three hundred and fifty feet. The rock is a red, finegrained eruptive rock, coursing north and south, and dipping to the east at an angle of 75 degrees; it is bordered by a red gneiss rock, which is also to be quarried for building purposes. The parties claim a very high crushing coefficient for it; also that it is absolutely indestructible by fire, having been repeatedly heated to a white heat and thrown into water without checking in the least.

PUENTE.

As this section of the county has been visited and described by Prof. W. A. Goodyear, E.M., in the State Mining Bureau Report for 1887, I will merely add that at present they have fourteen wells, situated in Sections 34 and 35, Township 2 south, Range 10 west, S. B. M. Their average depth is one thousand feet. All the oil is brought to Los Angeles, where it is mostly used for fuel purposes. There seems to be more shale than sandstone here, as compared with the Pico Wells.

SANTA ANA.

In the Santa Ana Valley, six miles from the town of the same name, in a westerly direction, at a place called Fairview, a number of artesian wells have been sunk with favorable results. They were sunk through strata of gravel, clay, and sand to a depth of over one hundred feet in some cases. In one of these, at a depth of eighty-seven feet, the drill passed through a large redwood log, a species of timber that is not found anywhere in the neighborhood at the present day. In another well that was sunk to a depth of over one hundred feet, the drill brought up twigs of oak, and also acorns.

To the east of Santa Ana, in the neighborhood of Santiago Cañon, on the spur coming down from the main range, lead, silver, and quicksilver ores have been found. The ores were shown us, but as the locations had not been secured, the exact locality was withheld.

EL TORO.

At El Toro Station, on the Santa Fe road, about three miles south of the railroad, is a deposit of limestone cropping out over the surface, at least over an area of twelve or fifteen acres. It is cut through by Aliso Creek, on the banks of which there is a highly tenacious clay that, used in conjunction with the limestone, will form a cement equal to the best Portland. Specimens of this clay were sent to the noted porcelain factory in Meissen, in Saxony. It made a fine quality of chinaware, but all of a pink color. The depth of this limestone or, indeed, its extent in any direction, could not be accurately stated, as the formation lies very flat, and no explorations have been made to prove it. It is fossiliferous, and is overlaid with arenaceous shale impregnated with salt. Not far from this, and possibly forming a part of it, we find, at the Modjeska switch, another bed of shell lime, which, with clay, makes good artificial cement. Here we have a distinct bed of clamshells striking northeast and southwest, dipping 10 degrees south, five feet thick. It is overlaid by fossiliferous sandstone and underlaid with limestone. Several years ago parties undertook to burn lime here, but owing to wrong dimensions of the furnace, and possibly admixture of adverse substances with the raw material, the enterprise failed. (See State Mining Bureau Report, 1889, p. 865.)

SAN JUAN CAPISTRANO

From El Toro to San Juan Capistrano is a distance of nineteen miles by railroad. The town is partly surrounded by low hills of soft fossiliferous sandstones, which extend down to the ocean, about two and one half miles distant. The altitude is three hundred and fifty feet. The range courses north and south, and dips slightly to the west. Two creeks run through the old Mission town, and unite before entering the ocean. The road northwest along the beach takes up over the mesa, which butts onto the ocean in bluffs of about one hundred feet in height, composed of unaltered sandstones and shales, and in some few places beds of cemented gravel. Along this beach in the debris, among other minerals, we found a specimen of chrome mica (fuchsite). Half way between San Juan by the Sea and Arch Beach is a dry creek that in the rainy season flows quite a body of water, and is called Salt Creek. Near where it has its head on the mesa the Mexican sheepherders procure rock salt and give it to their American neighbors when asked for it, but they will not divulge where it is obtained. Near where Aliso Creek empties into the ocean, and back inland a short distance, bituminous shales crop out, coursing apparently north 30 degrees west, and dipping at an angle of about 15 degrees. Arch Beach, a seaside resort, is situated seven miles north of San Juan. Back from there, about two miles on the range, a large amount of fossilized wood is picked up laying over the surface of the ground. At Arch Beach the bluffs are composed of layers of conglomerate rock and unaltered sandstones, with very thin streaks of limestone banded through it. The dip here is about 40 degrees to the west.

LASSEN COUNTY.

By E. B. Preston, E.M., Assistant in the Field.

As inadvertently some mistakes were incorporated in last year's report, in reference to the principal mining camps of Lassen County, the following partial repetition and correction has been made.

Lassen County, bordering on one of the best mining counties of California, being separated from Plumas County by a spur of the Sierra Nevada, has, so far, developed but little mineral wealth, a few claims having been prospected on Diamond Mountain, near Susanville, the county seat, that have yielded some gold. Veins of silver and gold ores have also been found on the southwest side of Eagle Lake, but mining as a regular business has only been prosecuted in the extreme north of the county, sixty miles north of Susanville, and nine miles from the Modoc County line, in what is known as Hayden Hill Mining District. This hill, named after one of the first locators, who is buried there, is one of the highest points of a spur running out on the eastern slope of the Sierra Nevada; its altitude is given as seven thousand five hundred feet. The mines were discovered nearly twenty years ago, since which time they have been more or less continuously worked, yielding to the world's gold supply a little over $1,000,000.

At the present date there are nine mines being worked on the southwest side of the hill, the most of which are extracting pay ore in more or less quantities.

The whole of the country is covered with a volcanic flow, making it extremely difficult to exploit for minerals. On the north side of the hill, exposures show a large bed of decomposed felsite; on the southeast side, are basalt and trachyte. Besides these we find conglomerates, breccia, altered sandstones, and arenaceous slates, with specimens of coarse-grained jasper, obsidian, volcanic tufa, etc. The action of heat and water are both plainly to be traced; in fact, it appears as if, after having been in active eruption in the near neighborhood of what now forms the hill, the fires have died out, leaving hot mineral springs to continue their solfataric action, until these likewise have disappeared, leaving the hill almost destitute of water.

There are two distinct systems of mineral veins—one a series of large quartz veins, with a general north and south trend, and dipping nearly perpendicular, very much eroded near the surface, containing but little gold in the croppings (never more than $5 or $6 per ton); and parallel to these, at no great distance, a younger system of fissures, having about the same course, but with an entirely different filling, being mostly country rock more or less decomposed, metamorphosed, and showing a large percentage of black oxide of manganese, with bowlders of quartz and quartz gravel, and in part, instead of a clay gouge on the wall, a layer of gold-bearing quartz, averaging two or three inches, firmly attached to the foot wall. It is on these systems of veins that the mining operations are pursued. The pay is in shoots mostly on the foot wall side. The walls are either felsitic or a conglomerate, pitching toward the older system of veins, and the ore seems to be richest where the felsite forms the wall. At a depth of about one hundred feet all through these veins there appears to be a barren streak. Little side feeders, running east and west across the main system, contribute to enrich the main veins for short distances, running the ore up from the usual average of $15 to $20 a ton to sometimes into the thousands. The gold is heavily alloyed with silver, being worth from $12 to $13 per ounce. Occasionally electrum is found with the gold. Also, from microscopical examination of the gold made at the State Mining Bureau, it was found that there are two qualities of gold in the veins—a gold that has been fused (this is found in the east and west feeders) and a gold that has been precipitated out of a solution (which is the quality of gold in the main vein).

None of the mines are worked to any extent below the three hundred-foot level. There is a great opportunity here to open all these mines through a deep tunnel that would cut the veins at a depth of seven hundred or eight hundred feet, but, for lack of unity and the necessary capital, it has never been started. The principal claims are:

The Providence, or Mount Hope. This was the first paying mine on the hill, and has yielded in the neighborhood of $125,000. At a depth of about one hundred feet they ran into a chalky clay-rock that cut off the pay, and for want of capital on the part of the owners to penetrate through this clay, the mine is not being worked at present.

The Golden Eagle adjoins the Providence on the east. This is one of the best developed mines on the hill. It is opened by tunnels and shaft to a depth of about three hundred feet. It is now being worked under a lease. This mine has a mill and water right about two miles from the mine.

North of this claim are the Brush Hill Claims, Nos. 1 and 2, formerly one full claim. It is now segregated. The one claim holds three fifths of the ground and the other two fifths. For a long time this mine kept a ten-stamp mill running on rock that averaged over $80 a ton. The average of the ore at present is $25 per ton. This mine has some water in the bottom, but not enough to require pumping engines. Brush Hill No. 1 is being worked by the owners; No. 2 has been under a lease. Both of these companies own small stamp mills, run by water power, about two and one half miles from the mines.

East, and adjoining the Golden Eagle, is the Excelsior Mine, worked by its owners through a shaft sunk on the vein, and they are meeting with good success. Their vein is presumably an extension of the Golden Eagle vein, but thrown out of the course by a large fault.

North of the Providence and northwest of the Golden Eagle and Brush Hill, is the Evening Star Company. They are working on an extension of the Golden Eagle and a cross of that vein with the Providence. This company has a shaft and a drift one thousand feet long to work through, that are connected at a depth of two hundred and forty feet. Besides this, they have a shaft down on the vein at the east end to a depth of one hundred and fifty feet. For nearly three hundred feet the tunnel went through a species of kaolin, that seems to dip under the hill on the north and west, and which is capped on top by a conglomerate rock. This mine has been the most continuous ore producer, although it does not show the largest output of gold.

The Juniper Mine has been in many respects the most remarkable of all the Hayden Hill mines, as in the course of three or four years, with four arrastras, it has produced half a million dollars; then at a depth of less than three hundred feet they met the clay, and since then no exploitations have taken place. Leasers have gone over the old works, finding it profitable to scrape down old walls and timbers, and work over old waste dumps, and it is in the hands of those men to-day, awaiting some man with energy and capital to further develop the property.

Adjoining this claim is the Blue Bell, which paid largely near the surface, but it is not being worked continuously at present.

This mineral belt can be traced by croppings north from Hayden Hill into Modoc County, but nowhere on it has any profitable work been executed.

SAN BERNARDINO COUNTY.

By James H. Crossman, Assistant in the Field.

Volcanic cones occur in this county, and the short mountain chains and isolated peaks, with which the desert region is dotted, are fissured with metalliferous veins. Among them, gold-bearing veins charged with the several ores of silver occur. Copper abounds in metallic form, and as carbonate, oxide, and sulphide. Ores of lead are found in veins of great strength. Immense bodies of iron ore are also met with, chiefly hematite and magnetic; the latter veins vary from twenty to one hundred feet in width. Pure rock salt is also found in large quantities, a more particular reference to which is made under a special head elsewhere in this report. Marble is found near Oro Grande, and in Colton, and in Old Woman's Mountain. Asbestus and mineral earths suitable for pigments are known to exist, although not yet available for commercial purposes. Aside from the supply by artificial reservoirs and natural sources, water can be obtained in many places in the desert, both north and south of the San Bernardino Range, by sinking wells. It is often reached within a few feet below the surface. One hundred and twenty-one completed artesian wells are said to furnish thirteen million gallons of water every twenty-four hours.

North of the San Bernardino Range of mountains the desert country contains the following mining and railroad towns: Victor, one hundred inhabitants; Oro Grande, one hundred and fifty inhabitants; Calico, four hundred inhabitants; Ivanpah, twenty-five inhabitants; Providence, fifty inhabitants; Barstow, one hundred and fifty inhabitants; Needles, four hundred inhabitants.

Providence, Kingston, and Clark's Mountain Ranges show, at an altitude of about four thousand feet, a considerable growth of timber that can be utilized; but below that level, the cactus, juniper, and sage, together with an occasional grove of mesquite, form the only fuel available. Fortunately the Gallup Mines in New Mexico furnish an excellent quality of coal. This is transported over the Atlantic and Pacific Railroad, and delivered at several points on the line of the road. In the near future, when the Utah Southern Railroad shall have extended its lines through these regions, excellent coal from Milford, in the Great Salt Lake Basin, can be laid down in San Bernardino County at a cost not to exceed $6 per ton.

STATISTICAL.

Within the confines of this county there are in operation sixteen quartz mills, dropping one hundred and eighty-seven stamps, the cost of which would be about $600,000. The silver bullion annually shipped from Daggett, owing to the low price of the metal, has not been so great for the past two years as before that time.*

The number of men employed in mining in this county is estimated at seven hundred.

THE TOWNS.

Victor is a station on the California Southern Railroad, and has an altitude of two thousand seven hundred and thirteen feet above sea level. It is the enterpot and depot for the mining districts situated in Holcomb and Bear Valleys, for the Old Woman's Springs, and the Morongo Gold and Silver Mines. It lies twenty miles southwesterly from Ord Mountain District. Close to the town are large quarries of excellent granite, which are constantly worked. The stone finds a ready market in the southern part of the State.

Oro Grande is situated on the banks of the Mojave River, about forty-five miles northerly from the City of San Bernardino. Lime is at present the principal product. It is shipped in large quantities to various parts of the State, and also to Lower California. Two large, double, patent kilns are kept constantly burning to supply the demand, and the business gives employment to a number of quarrymen, kilnmen, woodchoppers, and teamsters.

The adjacent hills and low ranges of mountains, within a radius of from ten to twelve miles, have long been known to contain veins of gold, silver, lead, and other minerals, which, owing to their rebellious character, cannot be worked by the ten-stamp mill erected for the purpose.

Difficulty in reducing these refractory ores will soon be overcome, however, as a fifty-ton smelter is being built for their special treatment.

The motive power will be water supplied by a ditch from the Mojave River, carrying one thousand five hundred miner's inches, with a thirty-foot pressure head at the outlet.

Barstow lies at the junction of the Atlantic and Pacific and the California Southern Railroads, and has an altitude of two thousand one hundred and five feet above sea level. Water for power is easily obtainable from the Mojave River, upon the south bank of which the town is situated.

Daggett is on the line of the Atlantic and Pacific Railroad, at an altitude of two thousand and two feet above the sea. It is situated near the banks of the Mojave River, about eighty-five miles in a northerly direction from the City of San Bernardino. This town is the receiving and distributing point for the extensive silver mines of the District of Calico, Ord Mountain, Lava Beds, Alvord, Solo, Silver Lake, Resting Springs, and the whole of the southern part of the Death Valley country. A great quantity of crude borax is shipped from Daggett, the product of mines in Calico Range, distant some twelve miles northerly from the railroad.

Calico was laid out as a town in 1882, and at that time active mining operations were commenced.

The first mill for the reduction of ores in this district was built at Hawley's Station, and after running about five years, caught fire and was consumed. During this period the town increased in size and population till, between 1882 and 1884, it became a place of eight hundred inhabitants. In the latter year it was almost wiped out by fire, but was rapidly rebuilt, this time with good, substantial edifices. But, unfortunately, in one year from the date of the first burning, a second conflagration laid the town in ashes. From the happening of the last calamity until the present time Calico has just about held its own.

Should the present Congress declare itself on the silver question in a way to enhance the price of that metal, there are many low-grade mines lying almost within the town limits of Calico that can be worked with profit.

---

*Note.—The value of the shipments of silver bullion from Daggett is difficult to determine, our assistant in the field having no guide in the matter, excepting by shipments through Wells, Fargo & Co. Estimate has been made from the opinions of business men in the county conversant with the facts.

MOUNTAIN RANGES.

In places on the northern slope of the San Bernardino Range of mountains, unaltered sandstones occur in immense quantities, particularly in the vicinity of Holcomb Valley. The elevation of the summit at Cajon Pass is three thousand eight hundred and nineteen feet above sea level.

Ord Mountain.

Eagle Peak is the name of the summit of this important eminence, and stands a marked feature in the landscape. Its central axis is granitic, with a northwesterly and southeasterly strike. Feldspathic, porphyritic, and many kinds of igneous rocks occur; both talcose and magnesian rocks are also seen.

The Lava Bed Mountain.

This mountain is a prolongation, in an easterly direction, of the Ord. Its course and stratification are north 22 degrees east. Clark's Peak dominates all others in the range, rising to an elevation of four thousand five hundred feet, and lies twenty-six miles easterly from Daggett in an air line.

The axis of this range is granite, so much metamorphosed by subterranean heat and thermal waters that its character is scarcely recognizable. Being in the immediate vicinity of two very distinct volcanic vents, within four or five miles easterly, it has felt their effects. This mountain is traversed by fissures, the strike of which is north 70 degrees west. They are filled with quartz and brecciated volcanic products of many varieties of rock.

Victor Mountain.

In this granitic range lie valuable quarries that are being worked and rapidly developed. The range is two miles long by one wide, with a northerly and southerly strike. Lying to the north is an extensive lime belt one mile in width, the strike of which is easterly and westerly, with a longitudinal extent of about twelve miles, where veins carrying gold, silver, copper, and lead occur.

Oro Grande Mountain.

This mountain is an isolated peak ten miles long by five wide at its widest part. Its direction is northerly and southerly, stratification northeast and southwest, formation largely volcanic, and composed of porphyritic rocks, volcanic debris, and a brecciated mass of material, through which run strong dikes and veins of metalliferous rocks.

The Avawatz Range.

About sixty miles in an air line, nearly due north of Calico, lie the Avawatz Range of mountains, which rise to an elevation at the highest summit of a little more than five thousand feet.

The axis of this range is similar to that of the Ord Mountain, which it resembles in a marked degree, both as to the character of its various rocks and their mineral contents. The course of this range is northwesterly and southeasterly; length about twenty-five miles; width about twenty. On its slope, and bordering on the western side of Death Valley, are found many valuable saline deposits.

Kaolin and foliated talc of the finest quality are also found in great abundance. Near the summit of the highest peaks some rich veins and deposits of gold, silver, copper, and lead have been discovered, and, ten years ago, were extensively worked.

About thirty miles easterly from Cave Springs, located some two miles and a half easterly from the summit of this mountain range, and on the road between Daggett, the Amargosa Borax Works, and Resting Springs Mines, a high range of mountains, gloomy and desolate-looking, loom up. This is the first range encountered after crossing the southern rim of the Death Valley basin, and is distinguished by almost perpendicular peaks; the highest, Kingston Peak, is a prominent landmark. The range and the peak, with the spring at its base, are named after Kingston, a former mail carrier between Salt Lake City and San Bernardino. On the northerly end of this range large deposits of argentiferous galena are found. These were extensively worked at Tecopa, once a flourishing mining town.

The general character of the rock is limestone (dolomitic). About six miles northerly from the above named place, in a low range, apparently an offshoot from the main one—the Kingston Mountain and District—occur the extensive argentiferous lead deposits that surround Resting Springs. Northward from the springs the range is badly broken, until finally lost in Ash Meadows, twenty-five miles distant.

Traveling about forty miles in a southeasterly course from Tecopa Clark's Mountain is reached, a place famous for the richness of its silver deposits. Its axis is a hard, blue limestone. The mining town of Ivanpah is situated at the southern base of this short range of mountains; on the southwesterly slope the Mescal mines and mill are located. Providence, a mining town in Trojan District, in the Providence Range of mountains, lies forty-two miles almost due south from Ivanpah. It is on the southeasterly slope of the range, in a region noted for the amount of rich silver and gold ores extracted from the many veins and deposits found within its confines. Southeasterly, at a distance of forty miles, the peculiarly marked range known as

The Old Woman's Mountains

Is reached, its extreme northerly point being eight miles distant in an easterly direction from Danby, a watering station on the Atlantic and Pacific Railroad. In the northwesterly portion or end of the range, and in the granitic and slate formations, small ledges, very rich in gold and silver, have been discovered within the last two years. During the same time a large and extensive ledge of carbonate of lead and galena was found, and developed considerably. This important ledge is traceable about eight miles. It runs through the mountain from its extreme northeasterly end to the extreme southwesterly extension, varying in width from ten to fifty feet. At the extreme southerly end, in a dolomitic limestone formation, some rich veins of silver-copper glance and horn silver have also been found; but, owing to the scarcity of water, little prospecting has been done upon them as yet.

Thirty-five miles from the above mentioned range is a well known landmark called

Old Dad's Mountain,

Which forms the southerly extension of the Providence Range of mountains. Standing out in desolate boldness, its lofty summit is covered with a scanty growth of scrubby nut-pine and juniper. The formation is granitic and porphyritic. Small ledges rich in gold have been found near its southeastern base, where a limited amount of development has been made.

In the mountains bordering on the west side of the Colorado River there has been but little prospecting and but scanty mining development.

RIVERS.

The Mojave,

The most important river in the desert of the same name, is formed by three forks, which take their rise at Halcomb Valley, in the San Bernardino Range of mountains.

From its source the course is northerly for a distance of seventy-five miles in an air line; it then takes an easterly direction for sixty miles, and finally sinks in Soda Lake. Within its entire length, about two hundred miles, the river in the dry season rises to the surface, and afterwards sinks eight times. Its first disappearance is at the forks, twelve miles above Victor, and its flow is subterranean for a distance of twelve miles. It rises at Victor and sinks again in the sand for five miles; appears again near Oro Grande, runs on the surface for five miles, and sinks between that place and Cottonwood Station, on the line of the California Southern Railroad; rises at Cottonwood, is visible for one mile, then sinks for a distance of fifteen; rises at Barstow, and is seen at this point for half a mile, then disappears for six miles, coming to the surface at Fish Ponds, runs a mile in view, and goes out of sight again for twelve miles. Coming to the surface again at Hawley's Station, this hide-and-seek river runs for about half a mile, then sinks and is not afterwards seen until Camp Cady is reached; here it is visible for a mile, where it sinks again for eighteen miles to rise once more at Cave Cañon. From this point the flow is visible for ten miles, till the river sinks for the last time near Soda Lake, excepting in the season of floods; then it rises twenty miles below the lake, and after uniting with the Amargosa disembogues into Death Valley near Saratoga Springs. During the spring months the river attains considerable volume, owing to the supply from melting snows, and is impassable where not bridged, excepting a few fords or crossings. From seven to nine months in the year the Mojave seldom carries less than ten thousand inches of water, miner's measurement.

Furnace Creek

Rises on the westerly slope of the southerly end of Grapevine Mountain, in the Death Valley or Funeral Range. It receives its supply, about two hundred inches, miner's measurement, from a spring pure and cold, and runs in a westerly direction for about three miles; then sinks in the sands of Death Valley. From this creek the extensive borax refining works of William T. Coleman & Co. obtain a supply of fresh water for domestic and other purposes.

The Amargosa

Has its source in the State of Nevada, about thirty miles southeasterly from the State Line Gold Mines in Gold Mountain, and makes its first appearance at the northerly end of the oasis in Nye County of that State. Its general course is southerly until after passing through the Amargosa borax fields, near Resting Springs, down through a deep cañon, close to the Salt Springs Gold Mines. There it suddenly changes to a direction almost due north, and is finally lost sight of near Saratoga Springs, Death Valley. The length of the Amargosa is about one hundred and forty miles.

It repeatedly comes to the surface, flows a short distance, and then sinks, its waters being absorbed by the sandy material, until a higher plane of bedrock is reached, when they emerge again to view.

During its flow the river takes up to its full capacity the alkaline salts in the soil through which it courses. When it comes to the surface the water is surcharged with them, and forms a dense briny solution, so perilous that, though to the eye it appears pure and wholesome, death follows to the man or beast that may chance to drink of the stream. When the action of the sun evaporates these fatal waters, the residue is soda, borax, and other alkaline substances.

The Silver Valley Land and Water Company.

At Daggett the "Submerged Dam and Water Company" has been incorporated, and works are being constructed to utilize the subterranean waters of the Mojave River as a motor, and for irrigation.

A submerged dam one thousand six hundred feet in length by twelve feet in height is being constructed at Fish Ponds, about three miles above Daggett on the river. The purpose of this dam is to convey the hidden waters of the river from this point by canal, flume, and pipe to and below the town. This will require three miles of canal, one thousand five hundred feet of tunnel, two thousand six hundred feet of pipe, and two thousand feet of fluming. The canal will be twenty feet wide at the top, fifteen feet wide at the bottom, and five feet in depth. Water will be taken out four feet below the surface, at an elevation of two thousand and fifteen feet above the sea, and discharged at a height of one thousand nine hundred and seventy-five feet, thus furnishing power for machinery and mills, and also sufficient water to irrigate a large tract of valuable agricultural land lying below the point of discharge.

The capacity of the canal will be fifteen thousand miner's inches; the grade, fourteen feet to the mile. The submerged dam will be a substantial structure of concrete cement and stone, of sufficient thickness at its base, resting on a bedrock of granite. Three reservoirs will be built on the line of the canal, each to contain five million gallons of water. These reservoirs will afford place for surplus water in the flood season.

Below the discharge point lie two hundred and eighteen thousand acres, surveyed and suited for agricultural purposes, a portion of which is owned by the company proposing to construct this canal.

Wheat and other cereals can be grown, also alfalfa and vegetables, together with citrus and semi-tropical fruits.

Outside of the company's possessions there is an area of one hundred thousand acres of the same kind of land, susceptible of irrigation. The waters of the projected canal can be taken to Soda Lake through Cave Cañon, and eastward as far as the valley lying south of Lavic Station, on the Atlantic and Pacific Railroad.

The Irrigating Ditch

Running from Lytle Creek, in the eastern part of the San Gabriel Mountains, is twelve miles long, and carries fifteen hundred miner's inches of water. Its dimensions are: four feet wide on the bottom, six feet at the top, and two and one half feet deep. It is cement lined, the grade two hundred feet to the mile, and the cost per mile $8,000.

This ditch irrigates six hundred acres in the northwest part of San Bernardino County. The irrigation season commences in April and ends in

October. Extensive reservoir sites can be secured on the line of this ditch. Catchment basins are numerous and not expensive to construct.

A large amount of water, much needed for irrigation purposes in this region, is allowed to run to waste.

The Oro Grande Canal.

At Oro Grande, a canal from the Mojave River carries one thousand seven hundred inches under a four-inch pressure, and has a thirty-two-foot pressure-head at delivery. This has been utilized for power to drive a ten-stamp mill, which is lying idle at present; the power will be used to run the fifty-ton smelter now being erected at this place.

VOLCANIC PHENOMENA.

At a place on the line of the California Southern Railroad, below the Point of Rocks Station, the first strong evidence of volcanic action may be observed. The rocks are metamorphosed and discolored; red, blue, yellow, purple, and green stains meet the eye. Signs of volcanic activity are seen from this point in northerly, northeasterly, and easterly directions for a distance of eighty-five miles. Volcanic cones occur, with craters on their summits, in many places. Streams of once molten lava, as fresh in appearance as if they had just ceased flowing, cover large areas.

The first volcanic cone of note is in the Ord Range, ten miles south 10 degrees east from Daggett; its lava flow was northerly, and discharged into what is now a dry lake, a basin-shaped depression lying east of Warm Springs. The next occurs in an easterly direction from Daggett, and distant from that place twenty-four miles. The flow from this crater was westerly six miles, and emptied into the same lake or basin.

The next extinct crater is of greater dimensions than the last mentioned, and is situated three miles easterly. The lava flow from this crater was easterly, discharging into another dry lake in Section 31, Township 9 north, Range 3 east. This cone has an elevation of about four hundred and fifty feet, with a base diameter of three thousand feet; the width of the crater at the summit is seven hundred and fifty feet, by one hundred and fifty feet deep. At that depth its pipe or shaft has an outlet, through which the lava was discharged. Dry Lake No. 2 has an area of about twenty-four square miles, on which two wells have been sunk, respectively sixty and ninety feet in depth, through earthy and volcanic debris. On reaching the lava an inexhaustible supply of nearly fresh water is obtained.

Southeasterly from this, at a point two miles and a half northerly from Ludlow Station, on the Atlantic and Pacific Railroad, four volcanic vents are found. Eighty miles distant, on the line of the same railroad, lying southwesterly from Siberia Station, another extinct volcanic cone may be seen, much larger than either of the others described. Easterly two others occur between Bagdad and Amboy Stations. There are eleven altogether, the two last mentioned being the easterly extremity of this special volcanic disturbance. From this point to the Colorado River, a distance of eighty miles, no evidence of volcanic action is met with.

Forty-five miles northerly from Bagdad Station, in Township 13 north, Range 12 east, San Bernardino Meridian, a volcanic center occurs where six extinct craters are seen, the lava flow from which covered the entire township site with scoric and molten masses.

The flow from these vents took a westerly course, and discharged into Soda Lake, the surface of which is now covered with an efflorescence of salt and soda over an area of seventy square miles. This lake is situated in Township 12 north, Range 8 east, and Township 13 north, Range 8 east, San Bernardino Meridian.

In the area first described, long lines of rents and fissures are seen, as well as craters with an immense quantity of breccia. The lava-bed range is a striking example of the many *volcanes de aqua* (water volcanoes) once existing in the area described.

One mile northwesterly from Daggett is Table Mountain, a marked feature in the landscape. It rises from its base to a height of two hundred and fifty feet, and one mile and one half long, by three quarters of a mile wide. Its sides have a gentle slope, and there is a bench of tableland on its top. This mountain is formed entirely of volcanic debris cemented into a solid mass of stone, which, after being cut and dressed, is used for building purposes in the neighboring town.

WARM SPRINGS.

The first evidence of thermal water in the Mojave Desert is seen at a point ten miles east of Daggett; elevation one thousand six hundred and seventy feet. These springs lie on the westerly edge of a dry lake, the dimensions of which are six by twelve miles. The surface is covered with alkaline and saline efflorescence. The lake has received the main flow of two now extinct craters. These springs furnish a steady flow of about ten inches of water, miner's measurement, varying in temperature from 50 to 85 degrees. In quality it is pure and without marked flavor.

In the Mojave Desert, northerly from this point, are a great variety of mineral springs of all temperatures from ice-cold to the boiling point.

Saratoga Spring is situated in Township 18 west, Range 5 east. The temperature of the water varies from 78 to 90 degrees.

The spring proper is a pool seventy feet in diameter, which overflows and forms a small lake. A person bathing in Saratoga Spring can sink no deeper than the chin; he stands on what is apparently quicksand, and the upward force of the rising water sustains him. This pool is filled with myriads of fish from two to four inches in length, resembling the species known as silver trout. As they strike the naked body of a bather, they cause a very unpleasant sensation. When cooked as pan fish they are good food, fat and palatable. Though the Chinese and Indians catch great quantities of them, the supply is not perceptibly diminished. The method of taking the fish is singular enough. A handful of cornmeal is put in a kettle or pan, which, on being sunk a little below the surface of the water, is soon filled with the finny prey. The utensil is then withdrawn, and the fish are ready to be fried without further trouble. The water is pure and wholesome, and its overflow forms a laguna, on the surface of which ducks and other waterfowl disport, feeding on the fish that come from these subterranean depths.

MINING DISTRICTS.

San Bernardino County contains within its borders the following mining districts, some of which, since their formation, have been subdivided. The names and boundaries of the subdivisions are given as accurately as possible under the circumstances.

Gold and Silver Mining District

Is bounded on the south and west by Deer Creek, on the north by the desert, on the east by Holcomb Valley.

Morongo Mining District

Is bounded on the northwest by the Black Hawk District, easterly by the desert, and south by the head of the White Water.

Brier Mining District

Commences at the northwest corner of Borax Lake District; thence westerly to the foothills to a point; thence southerly, following the foothills to a point; thence to the southwest corner of Borax Lake District; thence to the place of beginning.

Holcomb Valley District.

Boundaries unknown, but it comprises the area in Ranges 1 and 2 east, and Township 2 north.

Borax Lake District.

Boundaries unknown, but comprised in the area adjoining Brier District; twelve miles square, or four townships.

Ruby Mountain District.

The northwest corner is Horseshoe Mountain; thence westerly to the north of Rattlesnake Cañon; thence southerly to Antelope Springs; thence easterly to Gus Knight's mill; thence northerly to the place of beginning, comprising Township 2 north, Range 4 east.

Twenty-nine Palms District.

Comprising Township 1 north, Range 8 east; Township 1 north, Range 9 east; Township 1 north, Range 10 east; Township 1 north, Range 11 east; Township 2 north, Range 9 east; Township 2 north, Range 10 east; Township 2 north, Range 11 east; Township 3 north, Range 8 east; Township 3 north, Range 9 east.

Ibex (formerly "Sacramento Springs") District

Is bounded on the north by the old Arizona wagon road, on the east by the Colorado River, south by the Needles, and west by the Trojan Mining District, and commences at the northwest corner of Township 9 north, Range 20 east.

Burrows District.

Commences at the southwest corner of the mouth of Burrows Cañon, where the Mojave River enters into the desert; thence up the line of the river to the westerly line of the Holcomb Valley Mining District; thence northerly to the desert; thence along and skirting the base of the mountain and following the edge of the desert to the place of beginning.

Morongo District.

Beginning at the southerly corner of Warren's Well, running in a northwesterly line to the mouth of Rattlesnake Cañon, west to Granite Mountain; thence southeast to a point in Big Meadows due west of Warren's Well; thence easterly to place of beginning.

Solo District.

Commencing at a point on the northerly end of Cronise Lake; thence southerly to Mesquite Springs; thence easterly to Marl Springs; thence northerly to Halloran Springs; thence westerly to northeast corner of Five Point District; thence northwesterly to point of beginning.

New York District.

Commencing at the southwest corner of Township 12 north, Range 15 east; thence north twenty-four miles; thence east eighteen miles; thence south twenty-four miles; thence west eighteen miles to place of beginning.

Exchequer District.

Commencing at the southeast corner of Township 10 north, Range 19 east; thence north eighteen miles; thence west twelve miles; thence south eighteen miles; thence east twelve miles to place of beginning.

Grapevine District

Is bounded on the west by a dry lake, on the east by Calico District, south by the Mojave River, and north by the Mojave and Death Valley wagon road; commencing at the southwest corner of Township 10 north, Range 1 east, and running along the west boundary of Calico District to Paradise Springs, ten miles distant; west two townships; thence south ten miles; thence two townships east to place of beginning.

Temescal District

Comprises Township 3 south, Range 5 west, and Township 3 south, Range 4 west.

Ord Mining District.

Beginning at the southwest corner of Township 9, Range 3 east; thence north eight miles; thence to northeast corner of Section 15, Township 10 north, Range 4 west; thence south sixteen miles; thence west four miles; thence south twelve miles; thence west twenty-six miles; thence northeasterly to place of beginning at summit of the mountain.

Black Hawk District.

Commencing at Rabbit Springs; thence sixteen miles easterly to Old Woman's Springs; thence southerly to the east side of Cottonwood Cañon along the divide of the mountain to a high point easterly from the Nichols Furnace in Morongo District; thence westerly to Arrastra Creek Valley, passing the old Morongo Mine to the summit of the range dividing Bear Valley from Arrastra Valley; thence westerly along said summit to the head waters of Crystal Creek; thence northerly to the place of beginning.

Trojan Mining District

Comprises principally that section lying within the following limits: Commencing at northwest corner of Section 34, Township 9 north, Range 13 east, running north eighteen miles; thence east twelve miles; thence south eighteen miles; thence west twelve miles to the place of beginning. This district has recently been subdivided into three mineral districts: The Gold Belt District, on the west of Providence Mountain; the Arrow Mining District, on the south of Providence and east of Old Dad Mountain; the Trojan Mining District proper, the remainder.

Silver Mountain District

Is generally known as Oro Grande District, and commences at the old Stoddard Crossing on the Mojave River; thence east to Rabbit Creek; thence north to the old Panamint Crossing of the Mojave River; thence northeast to Cottonwood Station; thence west to the county line; thence south to Rock Creek Cañon; thence to the place of beginning. Commences at southwest corner of Township 4 north, Range 3 west; thence northeasterly to northeast corner of the northwest quarter of Township 4 north, Range 1 east; thence northwesterly to northeast corner of the southeast quarter of Township 8 north, Range 4 west; thence northeast to the southwest corner of the southeast quarter of Township 9 north, Range 3 west; thence west to San Bernardino County boundary line; thence south five townships; thence east to the place of beginning.

Lava Bed District

Comprises Township 7 north, Range 4 east, and Township 7 north, Range 5 east.

Alvord District

Is bounded on the west by Calico District, south by the Mojave River, east by Bitter Springs, north by Paradise Valley and Dry Lake. It is fifteen miles square. Commencing at the southeast corner of the southwest quarter of Township 10 north, Range 2 east; thence to the north boundary of Township 13 north, Range 2 east; thence east eighteen miles; thence southeasterly to southeast corner of the southwest quarter of Township 11 north, Range 6 east; thence along the Mojave River to the place of beginning.

Calico Mining District

Comprises Township 10 north, Range 1 east, the south half of Township 11 north, Range 1 east, and west half of Township 10 north, Range 2 east. Commencing at a point two miles and one half west of the Waterloo Mill or Little Red Butte; thence ten miles north; thence ten miles east; thence ten miles south; thence ten miles to the place of beginning.

The Clark District

Comprises the following area: Commencing at the southwest corner of Township 16 north, Range 12 east; thence north three townships; thence east to State line; thence along State line to the northeast corner of Township 17 north, Range 15 east; thence south two townships; thence west four townships to place of beginning.

The Scanlon Mining District,

Recently formed, is situated in Old Woman's Mountain, and is four miles wide by six long.

BUILDING STONE, ETC.

Granite.

The Snearer Quarry is two miles and a half north of Victor, on the east bank of the Mojave River. This quarry produces a fair quality of granite. Where it has been opened, the face is fifty feet in height and seventy-five feet in width. The rock is bluish in color, and in texture, fine-grained. Dimension stone can be quarried in blocks four feet square, or larger, if so desired. Twelve men are employed, and operations have been carried on for eighteen months.

The St. John's Quarry, half a mile south of Victor, owned by the Hesperia Land and Water Company, of Los Angeles, furnishes a good quality of granite for building purposes. It is of a grayish-blue color, very hard and compact, straight and smooth cleavage, dresses well, and takes a fine polish. The granite formation in which it is found rises to a height of two hundred feet above the Mojave River. Stone from this quarry is used in San Francisco for building, curbing, and street paving; also in Los Angeles, San Bernardino, and other cities and towns in the State. It lies in strata of great thickness. The overlying stratum has been opened for a length of seven hundred feet, and to a depth of fifty, on both the east and west sides of the ridge. The stone in the eastern development is less seamy than that in the western part, and generally of much better quality. A block recently taken from the east side workings measured nine by thirteen by sixteen feet. The strata dip easterly at an angle of 14 degrees.

Sandstone.

The Southern California Sandstone Company has opened a quarry and erected a mill at a point twenty miles north 70 degrees east from Colton, in the Yuciepa Mining District, above the mouth of Mill Creek, in Section 7, Township 1 south, Range 1 west, San Bernardino Meridian. The strike of this stone is northwest and southeast, dip 30 degrees southwesterly. It consists of two varieties, one hard and fine grained, the other a yellow, soft and coarse. The rock cleaves straight, dresses well, and can be quarried in blocks of any dimensions.

Lime Quarries Recently Opened.

Extensive quarries have recently been opened on a blue limestone belt situated in the Oro Grande Mountain Range. For the reduction of this stone eight kilns have been constructed at Oro Grande with a capacity of four hundred and fifty barrels daily. The stratification of the quarries is from northeast to southwest. Thirty men are employed at present, and the production of lime amounts to one hundred barrels per day. The subsidence of the building "boom," as the excitement was called in the southern part of the State, has materially decreased the demand for lime. The quarry is two hundred and fifty feet long, one hundred feet wide, and sixty feet in height.

Borax.

Extensive borax fields are worked in Death Valley, on the Amargosa River, by W. T. Coleman & Co. Searles Brothers own and work borax beds lying south of the Inyo County line, and south of the Coso Mountain Range. The material is found on the borders of a dry lake, ninety-six square miles in area. Colemanite is also found in San Bernardino County, in the Calico Range of mountains, near Daggett, also in small quantities in other localities; in places occurring in a bedded form, similar to that of a coal measure, dipping into the hill in which it occurs at an angle of 36 degrees, lying between walls of a dissimilar character, and would easily be mistaken for a true vein or a contact deposit, were it not for the surroundings and fossiliferous remains found in the underlying strata. This deposit is from four to nine feet in thickness, very regular in its deposition, with smooth walls.

GOLD MINING.

Following are brief descriptions of the various gold mines in the county:

Gold King.

Quartz; situated in the San Gabriel Range, Section 22, Township 2 north, Range 6 west. Scarcely any development.

Short and Ross.

Quartz; situated ten miles below the head of San Gabriel River. Vein twelve feet wide, with a shaft twenty feet deep. A mill is being built.

Ord Mines.

Quartz; situated in the Ord Range. The veins or lodes lie at an altitude of four thousand five hundred feet above sea level, and the mines are distant from Daggett about fourteen miles, or nine miles in an air line through the Ord Range of mountains, and course for an uninterrupted distance of four miles, on which fourteen full locations of one thousand five hundred feet each have been made. The northerly end of this lode contains copper as well as gold, while six of the southerly locations are strictly gold-bearing, the rock from which carries from $7 to $9 per ton. At and near the surface the ores are free milling, but as depth is reached sulphides of iron and copper appear. The vein is well defined, and dips easterly at an angle of 70 degrees.

The ore shoots are several hundred feet in length (four hundred feet in the Conpure), and have a southerly dip. Width of vein from four feet to one hundred (average, forty) in most of the mines. In the Conpure, as proved by crosscuts, it varies from sixty to one hundred feet. The vein can be undercut one thousand five hundred feet in length, giving backs of eight hundred and fifty feet. Southerly, the gold-bearing veins vary from eight to twelve feet in width.

There are good roads to the district, and both water and fuel are obtainable within reasonable distance.

The Black Hawk Mines

Are situated in the district ot the same name, fourteen miles from Rabbit Springs by road, or eight miles in an air line, in the Black Hawk Mountains, a spur of the San Bernardino Range. The trend of the chain at this point is easterly and westerly. On the northerly and easterly flanks, fronting the desert, a belt of limestone occurs, extending on the line of strike for ten miles, and from four to six miles wide. It is bounded by the desert on the north and east, and on the west by granitic rocks. It is in this extensive lime belt that the Hecla, Calumet, Lady Alice, and Santa Fe locations are made, at a height of six thousand and fifty to six thousand seven hundred and fifty feet above sea level. They lie on a foot wall of micaceous slate, which is underlaid, in turn, by syenite, dipping into the hill southerly at an angle of 45 degrees. The elevation of Cushingbury is four thousand and eight feet; elevation of the mine, five thousand five hundred and sixty feet at its lower workings.

The Rose Mine

Is located in the Morongo Mining District, southwest from Cushingbury, fourteen miles distant, at an elevation of seven thousand two hundred and fifty feet, and near the head of Rattlesnake Cañon, which empties into the desert, ten miles southwest from the settlement named above. This is a vein carrying much iron, and is four feet thick. Its strike is north 20 degrees west, and is inclosed in walls of micaceous and talcose slate. There is a shaft here one hundred feet deep. The croppings are traceable four thousand five hundred feet, and the rock shows free gold, reported to assay from $5 to $110 per ton. In the vicinity of this mine there are several small veins, rich in gold, worked by Mexicans. At a point about four miles easterly from a mine called the Morongo King, a vein of quartz crops out boldly and heavily, but it is bunchy and spotted. It strikes northeast and southwest and dips northwesterly. The mountain, where it is found, is composed of granite, micaceous slate, and quartzite.

Side Winder.

This mine is situated in Highland Mountain, at an elevation of three thousand eight hundred feet, five miles southerly from Stoddart's Wells, twenty miles south of Daggett, twelve miles east of Oro Grande, and twelve miles north of Victor. It is in the Silver Mountain Mining District (unsurveyed land), and has a metamorphic slate hanging wall with a syenitic foot wall. The vein crops for a distance of three thousand feet, and the value of the ore per ton is reported to be $25 to $50. This mine has an inclined shaft one hundred and twelve feet deep, the dip being 35 degrees, a drift eighty feet long, and several openings and shafts on the lode line for fifteen hundred feet. A drift two thousand feet long on the lode would give five hundred feet of backs.

The Sparkhule Mine

Is situated in Central Camp, Silver Mountain District, twelve miles west of Oro Grande. The vein is reported as carrying from $8 to $90 per ton in gold and silver, the latter in larger quantity than the former.

Imperial Mine

Is located nine miles westerly from Victor, also in the Silver Mountain District. The walls of the vein are granite, and the gangue quartz; width of vein from seven to ten feet; it will yield about $9 per ton. The vein is traceable one thousand feet in a northeasterly course.

The Oro Grande Mine

Is situated in the mountain of the same name, and in Silver Mountain District, at an elevation of three thousand seven hundred and fifty feet. The gangue is quartz, laminated, and with a clay gouge on both walls, which are porphyry and granite.

A well timbered shaft, two hundred and fifty feet deep, with the proportions six by nine feet, has developed the mine to that extent. There is also another shaft (No. 2), one hundred feet from the first, which has been sunk fifty feet, and shows two feet of quartz. The quartz in this mine carries pyrites, and is reported to yield $12 per ton in free gold.

The remoteness of the Oro Grande property from water, however, and the cost of transportation, compelled the company to stop work, notwithstanding they owned a good ten-stamp mill in connection with the mine.

The Oro Fino.

This property is situated in Silver Mountain District, ten miles from Oro Grande, at an elevation of three thousand seven hundred and ninety feet. The strike of the vein is east and west, and the formation feldspathic granite. The lode is from six to twenty inches wide, and carries high-grade gold rock. The mine lies idle.

The Whatnot Mine

Is situated on Whatnot Hill, in the Oro Grande Range, Silver Mountain District, three miles and a half easterly from Mojave River. The vein strikes north and south, with a width of from ten to twelve inches; the gangue is quartz. It is developed by a tunnel three hundred feet long on the vein, with shafts to the surface, and some winzes and crosscuts. The vein is spotted, and occasionally rich, the assays being $60 in gold and $20 in silver, per ton. Syenite forms both foot and hanging walls.

[From the northeastern portion of the county many recent gold discoveries have been reported, but as yet have not been visited by the Bureau's assistants in the field.]

SILVER MINING.

The Morongo.

This mine is located ten miles southerly from the Black Hawk, at an elevation of six thousand three hundred feet, in Bear Valley Mining District, Black Hawk Range of mountains, six miles east from the valley. Strike, north 70 degrees west; formation, lime shale; gangue, quartz. A streak of ore follows the hanging wall, with three feet of good ore on the foot wall. Vein sixteen feet thick, with a shaft one hundred feet deep. Drift, ten feet; crosscut, ten feet to foot wall. The lode dips northeast 55 degrees. One hundred feet westerly a shaft is sunk twenty feet, exposing ten feet of ore mixed with waste, with two feet of the ore on the hanging wall; thence one hundred feet westerly, the vein is cut off by a cross course. Much work has been done on this mine, with, as yet, but little result.

The Silver Belt.

This mine is located in Galena Camp, Silver Mountain District. It shows a vein of lead ore, carrying thirty-four ounces of silver to the ton, and $9 in gold. Vein twelve inches thick; little development.

North Camp

Lies seven miles in a southwesterly direction from Oro Grande, in a low range of light-colored hills, with a dolomitic limestone formation. It has the following veins:

Lillie.—Strike, north 20 degrees west; dip, southwest 75 degrees; gangue, quartz; formation, magnesian limestone. Ore, bunchy, but rich, and assays two hundred and thirty-four ounces in silver. Vein thin.

Pontiac.—A two-foot vein carrying brittle silver and chlorides; formation, dolomite. This vein is traceable for one mile and a half on its line of strike; gangue, quartz. Numerous feeders of high-grade silver ore lead into this vein. There are, it may be added, quite a number of small veins, varying from inches to feet, coursing through the hill in a northerly and southerly direction, and carrying very rich ore, such as the Golden Heaven, the Golden Chord, Little Turtle, etc.; but scarcely any work has been done upon them.

A Group.

On the north side of North Camp Mountain, twenty miles from Oro Grande, occurs a group of silver-bearing veins, with quartz gangue. These veins are in a dolomite formation, and have an easterly and westerly strike. The Clip Springer and Cornet are the most prominent in value among the locations.

West Camp

Is in Silver Mountain District, twelve miles westerly from Oro Grande, in a low mountain range composed for the most part of magnesian stratified limestone, syenite, and porphyry, through which runs, in a northwesterly and southeasterly direction, a strong, well defined vein, carrying gold, silver, and lead. The most marked and persistent in the line of strike are the locations known as Twenty-Nine, The Stranger, and The Clincker group.

Twenty-Nine has a three-foot vein, rich in silver; strikes northwest and southeast; walls, blue limestone on the east and dolomite on the west. This vein is highly mineralized.

Clincker No. 1 has been developed by two shafts, respectively sixty and thirty-five feet deep, and lying six hundred feet apart.

Clincker Nos. 2 and 3 are parallel veins, lying three hundred and fifty feet easterly from No. 1.

The Side Issue lies parallel, three hundred and twenty-five feet west of the Clincker vein. It is from one to three feet in width, and is developed by an inclined shaft sunk in dolomitic limestone. The ore is a copper silver glance. Strike of vein, north 10 degrees west.

The Commercial

Carries from two to three feet of a vein lying parallel with the Side Issue, and which crops for fifteen hundred feet. The vein lies between porphyry and limestone. The ores carry copper and silver.

The Capital

Lies two hundred feet easterly from the Commercial, and courses northerly and southerly. Vein from three to twenty-six feet wide; ore averages fifteen ounces in silver to the ton; developed by Shaft No. 1, fifty-five feet deep, and Shaft No. 2, sixty-nine feet deep. The vein is inclosed in a formation of porphyry and stratified limestone, and is traceable on its line of strike for six thousand feet. Water can be obtained from Dry Lake, one mile and a half distant, in any quantity desired.

The General.

This mine lies on the west side of West Camp Mountains, in the vicinity of Dry Lake, and is six miles east of the Los Angeles and San Bernardino County line. It is developed by a shaft seventy feet deep.

The Boss Mine

In this vicinity. It courses north and south; gangue, quartz. The vein is from two to eighteen inches wide; formation, blue limestone on the east and porphyry on the west; strike, north 20 degrees west. Ores carry gold and silver; assays vary from $20 to $72 to the ton.

Central Camp

Is situated in a distinct and separate hill or eminence lying midway between the Galena and West Camps, in Silver Mountain District. The veins are strong, and lie between limestone on the east and prophyry on the west, varying from five to ten feet in width. Development is by a shaft fifty feet deep, with several shallow pits on the line of the lode.

The Blue Jay, or Homestake Mine,

Is located in Silver Mountain District, four miles easterly from Oro Grande and ten miles northwesterly from Victor, at an elevation of three thousand seven hundred and fifty feet. The formation is syenitic, porphyritic, and calcareous; strike, easterly and westerly, dipping south 45 degrees; vein, four feet thick; ores, copper and silver. The mine is developed by a sixty-foot shaft and a forty-foot crosscut, all in ore that carries forty-seven ounces of silver to the ton. Vein has a porphyritic foot wall and limestone hanging wall.

The Blue Jacket

Is located in the Oro Grande Range of mountains, at an elevation of three thousand three hundred feet above the level of the sea, three miles and a half east of Ore Grande, in Mineral Hill. Formation, dolomite; strike, northeast and southwest; vein, eight feet wide, quartz and calc spar inclosed in dolomitic walls, with a strike north 10 degrees east; minerals, iron, copper, and silver. The mine is developed by a shaft forty feet deep, all in ore of good character. An eighty-foot shaft has been sunk one hundred feet southerly, and the vein shows a width of eight feet; ore friable. At this point a strong vein eight feet wide enters from the west. The ores from this mine were reduced at the Oro Grande Mill, with unsatisfactory results, owing to their rebellious character; they are rich in silver, but base. After the ore was worked operations ceased, and have been suspended for three years, with the exception of the necessary assessment work to hold the claim.

The Carbonate Mine

Is also located near Oro Grande, in the Silver Mountain District. Though classified as a lead mine, and carrying carbonates with a high percentage of both silver and gold, it is entitled to a place under the head of "Silver Mines," as it assays fifty ounces per ton of silver. For particulars of development, see "Lead Mines."

Lava Bed District

Is in the Lava Bed Range of mountains, an easterly extension of the Ord Range, south 80 degrees east from Daggett, twenty-six miles by wagon road, and at a point nearly opposite Lavic Station, on the Atlantic and Pacific Railroad.

Its formation is syenitic and porphyritic, and where showing stratification, coursing north 22 degrees east. Highest altitude of mountain, four thousand one hundred and seventy-five feet. The aneroid shows, at the base, an elevation of two thousand one hundred feet. In this mountain there are several powerful veins cropping boldly, and for long distances, to heights varying from ten to fifty feet, and traceable for more than a mile on their line of strike.

The Pequod

In this district has a strong vein, but little developed.

The Tip Top

Lies at an elevation of three thousand seven hundred feet. Strike of vein, north 70 degrees west; dip, northeasterly 45 degrees. The vein is ten feet wide, showing a dark ferruginous ore, carrying gold. Eighteen assays gave an average of $24 50 per ton.

The Everett Mine

Lies at an elevation of two thousand nine hundred and fifty feet. The vein shows a width of eighteen feet, four feet of which assay seven ounces of silver to the ton; nine feet barren, and five feet ore next the hanging wall. There is a shaft sixty feet deep; west drift, thirty feet; east drift, twenty-five feet.] [Walls smooth and well defined.

Mammoth Mine,

Lying in Lava Bed District, has a strike north 70 degrees west; dip, south 80 degrees. The vein is banded, with four feet of good ore on the south wall. It is from twenty to forty feet wide, and crops out boldly the full length of the claim. Ores, carbonate of lead, galena, and silver. In an easterly direction, up hill, the croppings are also prominent, but the vein is considerably disturbed and broken, volcanic matter appearing instead of quartz. At an elevation of three thousand three hundred and seventy-five feet it resumes its proper shape. The shaft is twenty feet deep, and the ore assays (as reported) ninety-five ounces of silver per ton. On the summit, at an elevation of three thousand four hundred and fifty feet, a thirty-foot shaft exposes a vein twenty feet wide, carrying considerable baryta. Ore said to assay from fifteen to twenty ounces per ton.

The Meteor Mine

Is an extension of the Mammoth, where the vein, nine feet thick, crosses a ravine; dip, south 80 degrees; croppings bold; ore said to assay twenty ounces in silver to the ton. Eastwardly the ledge increases in size to twenty feet, composed of quartz and a brecciated volcanic mass of rock. In the center of the claim a crosscut is run through the country rock for eighteen feet. Drift on the lode, thirty-eight feet; shaft ninety feet, with good ore on the bottom. The ores are soft carbonates, with bunches of galena which run high in silver. It is reported that the mine has yielded $20,000 worth of silver. Two hundred feet eastwardly from the above point, a crosscut of forty feet and a drift of the same length have been run, showing four feet of good ore.

The Morning Star.

This mine lies at the extreme easterly end of Lava Bed District, at an elevation of three thousand and fifty feet, at which point a tunnel has been run westwardly on the lode. Strike of lode, north 70 degrees west. Vein crops boldly thirty-five feet in height by one hundred and fifty feet long. There are four feet of ore on the south wall, said to be good for thirty ounces per ton. Westwardly three hundred and fifty feet up the hill, at an elevation of three thousand five hundred and fifty feet, Tunnel

No. 1 has been driven on the lode. From a short crosscut, connecting with a shaft seventy feet deep sunk in good ore, some stoping has been done. Two winzes have gone down on ore: No. 1, thirty feet, and No. 2, seventy feet. Tunnel No. 3 runs on the south wall of the vein carrying four feet of poor ore, then crosses at an angle of 18 degrees for one hundred and fifty feet through the vein near the west boundary line. At an elevation of three thousand six hundred and twenty-five feet some good ore in croppings twelve feet thick. Vein twenty feet wide between walls. South of it, two hundred and fifty feet distant, is a spur carrying four feet of galena, but only $7 in silver. Other spurs of galena fall in on the north side of the lode, on one of which an eighty-foot tunnel has been run.

The Rising Sun

Lies parallel with the Mammoth, in Lava Bed District, on the northerly side. Width of vein, eight feet; formation is similar to the Mammoth. The mine is developed by a seventy-five-foot tunnel, and an open cut in the middle of the claim. Assays of the ore vary from forty to fifty ounces of silver per ton. Ore irregular; vein spotted. At this elevation a fine view of both craters, five miles apart, with the old lava flow therefrom, is obtained. Distance to railroad, seven miles. At a dry lake two miles and a half eastwardly from the mines, two wells have been sunk; one sixty, the other ninety feet deep. The supply of water is inexhaustible, but slightly brackish. Elevation of lava mesa, two thousand five hundred and seventy-five feet; diameter of Dry Lake, east and west, five miles; elevation, one thousand nine hundred and twenty-five feet. Elevation of Warm Springs Lake, twenty miles westwardly from the mines, one thousand nine hundred and twenty-five feet.

The ores of zinc and antimony, carrying silver, abound in many parts of the county.

COPPER MINING.

Veins of cupriferous ores are found in Ord Mountain, in the Ord Mining District. Elevation of the mountain above tide-water is four thousand five hundred feet. It is easily accessible by wagon road already built to Daggett, fourteen miles northerly. The veins mentioned course northerly and southerly, with a dip 70 degrees easterly. They are inclosed in walls, differing in formation, and which sometimes have a clay gouge. The veins carry copper and gold.

The copper ores are carbonates, oxides, sulphides, and metallic copper. The latter lies in a formation of clay, eight to ten feet thick, adjoining the lode proper.

The roads to Daggett are smooth, and of easy grade. Ores can be hauled by contract to that place, from any of the mines, for $1 50 per ton. Water can be obtained in Daggett free of cost. Coal costs $9 per ton. The mines can be opened by an adit driven on the vein, giving a vertical depth of eight hundred feet of backs.

At Old Woman's Springs,

Near Morongo Pass, in the Morongo District, copper veins are found, carrying gold.

In Clark District

The Copper King Mine is located. The foothills of the Colorado River Range of mountains, near the river of the same name, have been celebrated for strong veins of high-grade copper ores, and they also occur near the Ibex Tank and Sacramento Springs, nine miles westerly from the middle of the Colorado, and in the foothills of Big Timber or Charleston Range of mountains.

Near Good Springs rich deposits of copper are also found.

Copper is also met with fifteen miles southeast of Ord, and fourteen miles northeast of Old Woman's Springs. Formation of walls, slate and limestone. Developed by shaft sixty feet deep, showing a four-foot vein, the ores of which are principally sulphides.

LEAD.

Lead is found in Rattlesnake Cañon, Morongo District, four miles east of the Rose Mine. Here the Lawrence Mine is located. The formation is granite and micaceous slate, and the vein is four feet in width; strike, north 80 degrees east. Galena is the character of the ore, developed by a forty-foot shaft and an open cut.

The Morongo Mine

Is in Bear Valley District, and carries four feet in width of argentiferous lead ores. Silver lead ores also occur at other points on the southerly edge of the lime belt adjoining the granite, which forms the axis of the Bear Valley Range. Little work has, however, been done upon them. The ores carry from five to twenty ounces in silver per ton, and from $9 to $10 in gold. The Colorado Mine is in this formation, with a shaft down seventy-five feet, and a drift of forty feet, showing four feet of ore containing some carbonate of lead and galena.

Galena Camp

Lies in a low range of hills, south 70 degrees west from Oro Grande, which is seven miles distant. The hill inclosing the Lucky Tom, Nos. 1, 2, and 3, is one mile long and three thousand feet in width. The vein is twenty feet wide. Strike, north 20 degrees west. Hanging wall, stratified limestone; foot wall, syenite. The ores are silver-bearing carbonates of lead and galena, developed by a twenty-foot shaft.

The Silver Belt

Lies one mile northerly and runs parallel with the Robin Hood vein; but little developed. It shows a width of twelve feet, and carries gold and silver as well as carbonates of lead and galena. The veins are from three to fifty feet in width. They are in limestone.

The Harrison Mine

Is located four miles and one half northeast from Oro Grande. The vein is five feet in width, with walls of blue limestone. Ores, galena, and zinc blende carrying silver; but little development has been made, owing to the want of a smelter in the vicinity.

The Carbonate Mine

Is in limestone, and lies two miles east of the town of Oro Grande, on the western slope of the Oro Grande Mountain.

The vein underlies a body of blue limestone, remarkably pure. The property is in course of active development by a full force of miners.

Strike of vein, north 80 degrees east, dipping north at an angle of 45 degrees; it varies in thickness from eighteen to twenty-four feet.

Adjoining this vein, twenty-five feet distant, a parallel vein of the same character occurs, on which an eighty-foot inclined shaft has been sunk, at the bottom of which the ore is said to assay one hundred and forty ounces of silver, $16 in gold, and 40 per cent of lead. Another shaft, one thousand feet distant, has been sunk to a depth of one hundred feet; the ore is reported to assay 57 per cent lead and six ounces of silver.

The Stonewall Jackson

Lies six miles northwesterly from Barstow, and in the vicinity of the Waterman Mine, in the Grapevine Mining District, four miles and a half northeast from Hinckley Station, on the Atlantic and Pacific Railroad. Elevation, two thousand two hundred and twenty-five feet. Strike of vein northwest and southeast. Developed by an inclined shaft thirty-six feet deep; dip of lode for twenty-eight feet, 40 degrees; for eight feet, 60 degrees; thickness of vein at bottom of shaft, eight feet; ores, oxides of iron and carbonate of lead. There are a number of locations on this vein.

The Beauregard

Is located on this vein. Elevation, two thousand one hundred and fifty feet, with a northwesterly strike; same character of ore in crosscut. The vein shows a width of ten feet, with hanging wall not reached; dip, 45 degrees.

Next adjoining claim northwest on the line of the lead is the Honeycomb. It runs seven hundred and fifty feet northwest and southeast of the discovery shaft, which is nine feet deep and twelve feet wide.

Next claim northwest is the No Name. Elevation, two thousand one hundred and thirty feet; shaft, thirty-five feet deep, all in ore (iron oxide and carbonate of lead with copper stains). Another shaft is sunk about two hundred feet distant to a depth of forty feet. Inclination of lode, 65 degrees.

The Ventura Claim comes next. Elevation, two thousand one hundred feet. Shaft, sixteen feet deep; four feet of ore of the same character as that in the Honeycomb Mine.

Next location is called the Jupiter. Elevation, two thousand one hundred feet. Shaft, eight feet. Vein dips at an angle of 60 degrees east. Same character of ore.

The Cleaveland Mine

Is located on a lone mountain near the boundary line separating the Calico from the Grapevine Mining District; distant five miles northwest from Daggett, and four west from Calico. The mine is in Grapevine District. It has been developed by an inclined shaft one hundred and seventy feet deep on a dip of 35 degrees east. The ore body exposed is fourteen feet wide, the richest portion being on the foot wall; carries some silver. Hanging wall porphyry; foot wall a decomposed feldspar. Average value of the above described ores, treated at the Selby Smelting Works, San Francisco, as a test, 26 per cent lead and twenty ounces silver.

The Cuticura

Adjoins the Cleaveland, and runs parallel with it on its westerly boundary line. The formation is calcareous rock, much changed. Strike of the vein is northwest and southeast, dipping northeasterly at an angle of 60 degrees.

Gangue, siliceous; ores, carbonate and oxide of lead, bearing silver. Vein four feet wide between well defined walls of lime and quartzite, developed by a sixty-foot shaft and several surface crosscuts.

The Midnight

Is on the same vein, being the easterly extension of the Cuticura. It is traceable its entire length of fifteen hundred feet, and shows the same class of ores. Slight development.

The Harrison Mine

Is located in Silver Mountain District, three miles and a half easterly from Victor Station, on the California Southern Railroad. It is in a limestone belt. Width of vein, four feet; strike, north 20 degrees east; ores, zinc and lead, carbonates and sulphides. Large deposits of silver-lead ores are said to exist at other places in San Bernardino County, and in other counties tributary to it, particularly at Resting Springs, Solo District, Five Points, Good Springs, Old Woman's Mountain, and New York District.

IRON, MAGNETIC AND HEMATITE,

Is found in Lava Bed Mining District, Sections 27 and 28, Township 6 north, Range 4 east, S. B. M. Two massive veins occur on the southerly slope of the range of mountains in this district, a southeasterly prolongation of the Ord Range. The range proper, last named, is about thirty miles long from its extreme southeasterly to its northwesterly point.

The place known as Iron Mountain, where these immense deposits lie, is situated about eighteen miles southerly from Newberry Station, on the Atlantic and Pacific Railroad.

The Lava Bed Range of mountains is entered on its northern border through a narrow gorge. The rocks on both walls of this pass are jagged, sharp, angular, and black, and stained by the oxides of iron. At the entrance this defile is fifty feet in width by two hundred feet in height, vertical in places, in others slightly inclined. Passing in for four hundred feet, an amphitheater is reached, which possibly may have been a volcanic crater. This space is surrounded by rock of the same character as on the walls of the pass or gorge. Thence, in a southerly direction for five miles, volcanic rocks, tufa, and sandstones of volcanic material are found. Reaching the summit, at an elevation of three thousand eight hundred and eighty feet, all traces of volcanic action have disappeared.

The rocks are granitic in character on the southerly slope of the mountain and at its base. At an elevation of three thousand and twenty-five feet is found the iron deposit under consideration, eight miles from the summit. The mines are named: Dick Turpin, Nos. 1 and 2; Tip Top, Nos. 1 and 2; and Bessemer, No. 1.

These veins are well defined, with dissimilar walls, and with a selvage, or, as more commonly called, a clay gouge. They course north 20 degrees east, and dip into the hill northwest, at an angle of about 30 degrees.

The Tip Top and Dick Turpin are separated by one hundred and fifty feet of syenite, and lie nearly parallel, continuing in their southerly course at a small angle of inclination. The Turpin ores are remarkably pure, and highly magnetic. The Tip Top is the northerly vein, and lies at an elevation of three thousand two hundred and five feet. The vein is composed of hematite and magnetic iron, with a gray, soft material known as nut ore. It courses north 70 degrees west. Its northern wall is an irregular belt of dolomitic limestone; the southern, syenite.

At this point the vein is thirty feet in width, increasing in strength to one hundred and fifty feet, as the hill is descended four hundred feet.

The ore occurs as a defined vein in place, not in beds, as usual. The dolomitic formation that bounds the Tip Top, on the north, is irregular in form and strike, and is, in turn, bounded by the granitic rocks, a prolongation of the Ord Mountain Range.

The strike of the Bessemer No. 1 is due north and south, and it also shows a strong body of magnetic ore, reported free from phosphorus and sulphur.

This mine has been but little developed. Some small pits and a ten-foot shaft are the extent of the work.

The ore body is traceable from its northeasterly exposure, at an elevation of three thousand three hundred and fifty feet, in a southwesterly direction, through the low foothills, at an elevation of three thousand and twenty-five feet, for a length (on the line of the strike) of three thousand two hundred feet, with an average width of eighty feet, widening in places to four hundred feet.

Four miles southeasterly from this point, and on the same mountain range, an extensive body of highly magnetic iron ore occurs, the maximum width of which is one hundred feet; the minimum, twenty; course and strike of vein, same as above.

Kingston Mountain and Resting Springs are also reported to contain magnetic iron, as well as many other places in this county.

ZINC.

The Harrison Mine, described under the head of "Lead Properties," and situated three miles and a half from the town of Victor, carries an ore body of four feet in width, stated to assay 27 per cent zinc.

ASBESTUS.

The mine known as "The Scorpion" consists of two locations. It is situated in the low range of hills two and a half miles westerly from the Mojave River, and fourteen miles northerly from Rio Grande.

AURIFEROUS GRAVEL,

Of the San Gabriel Range, etc.

On Lytle Creek, thirteen miles northwesterly from Colton, auriferous gravel is found. From the mouth of the cañon northerly, five miles, to Pratts, there is more or less of it, and considerable work was once done here. The available places, however, are nearly exhausted, and work has been discontinued for a long time. At Texas Point some $80,000 is reported to have been taken out by hydraulic process. Above this point the ravine spreads out in flats, covered by large granite bowlders.

Crossing the ravine near Glenn's ranch, Township 2 north, Range 6 west, Section 22, a vein of gold-bearing rock occurs, which give a good horn-spoon prospect, showing free gold; but no work has been done on it, other than sinking a five-foot shaft. Near this place is a thermal spring, with a temperature of 95 degrees. Elevation, two thousand six hundred and five feet above sea level.

On the headwaters of the San Gabriel River, close to the line on the Los Angeles side, and westerly from the point above mentioned, ten miles from its source southerly, and thirty-five miles westerly from Glenn's ranch, on the western slope of the San Gabriel and Lytle Creek Ranges, lies the San Gabriel Gold Mine.

A shaft twenty feet in depth has been sunk, exposing a vein twelve feet wide, and a quartz mill is being built on the property. The ore is said to yield $12 per ton.

Wood is abundant. With a good water power, low grade ores found in this vicinity can be handled at very small cost per ton, and made to pay a handsome profit.

On the northern slope of the San Antonio Peak, at an elevation of eight thousand one hundred and forty feet, a dead river channel of auriferous gravel was discovered in the summer of 1882. In many respects this gravel resembles that of the pliocene beds so extensively worked in the middle and northern counties of California. The gold is nine hundred fine. This range is being developed by three companies, each owning one thousand five hundred feet of ground.

The Bald Mountain Gold Mines are in successful operation. Width of channel (ascertained by crosscut), two hundred to two hundred and fifty feet. Its course is northwest. The present workings are on the westerly rim of the channel.

Water is obtained from melting snows and caught in reservoirs of small dimensions. It is used under a three hundred-foot pressure-head through a six-inch pipe, with two and a half by three-inch nozzle.

The season is necessarily short, commencing in May and ending in November. The gravel first passes over a grizzly, then through three sixteen-foot boxes, sixteen inches wide and twenty-four inches deep, set at a sixteen-inch grade to the box. Quicksilver is not used in the boxes or ground sluice, but in the under-currents; cross riffiers, two by four, are used in the boxes, set at a sharp angle, one inch and a half apart.

The mine is only worked by day, but the yield is reported at $8 daily to the hand. Six men are employed.

At the head of the San Gabriel Cañon, in Los Angeles County, northwesterly from this point and at about the same elevation, the same character of gravel is seen.

The gravel banks on the San Gabriel River are known to be rich, and several companies were formed to work them; but for some reason all the projects fell through. At one time an English stock company was organized for this purpose, but called a halt after incorporating and selling a few shares of stock.

At a point on the eastern terminus of the Bear Valley Range (a spur of the San Bernardino Range), near the mouth of Cook Cañon, gold placers have been worked by dry washing for many years. At present they are still operated to a limited extent by a few Mexican miners. The ground is extensive and rich, but no water has ever been taken upon it. It is reported that $8 per day to the hand is not an unusual yield.

MILLS AND REDUCTION WORKS.

Oro Grande

Contains one ten-stamp mill erected by the original Oro Grande Mining Company. It first dropped stamps in 1878, on ores from the Silver Mountain Mining District. Subsequently it was sold to the company still retaining the name, but their operations are now carried on in Calico District, and the Oro Grande Mill lies idle.

Daggett.

In the town proper there is a good five-stamp custom gold and silver mill, but worked irregularly. It was erected in 1885. This mill, it is expected, will be kept constantly employed during 1890 on custom ores from outside districts. Daggett has also a sampling plant lying idle. The Waterloo Mill of sixty stamps, and the King Mill of fifteen stamps, both belonging to the Oro Grande Mining Company, are located on the banks of the Mojave River, one mile in a northerly direction from Daggett. The mill last named was erected in 1882, and has been constantly in operation since that time. The Waterloo was completed in 1888, and is kept steadily at work on ore from the mine that bears its name.

A large area containing valuable mines of gold, silver, lead, and copper lies within a radius of one hundred miles, and would naturally be tributary to Daggett, or some other central point where suitable reduction works could be erected on an extensive scale.

Waterman.

This two-stamp mill was built in 1881, and after running for six years, has lain idle since 1887.

Camp Cady

Is an old Government military post, twenty miles easterly from Daggett, and has a five-stamp gold mill, which is occasionally run on ore from the Alvord Mine, some nine miles away in a northerly direction.

Holcomb Valley.

At this place a five-stamp gold mill is kept constantly at work on custom ore during the summer months.

Ivanpah.

Here there are two mills, with respectively five and ten stamps each, employed in reducing ore from the Clark Mining District.

Providence (Trojan District).

At present there is but one five-stamp mill at work here on the ores from the Perseverance Mine. The ten-stamp mill of the Bonanza King, destroyed by fire in 1887, has never been rebuilt.

Rattler District.

The Virginia Dale Mining Company of San Bernardino County erected a five-stamp mill upon their property in 1887. The cost of mining and milling was too heavy, however, and operations were suspended in 1889. This property is situated about thirty-four miles south from Cadiz, a station on the Atlantic and Pacific Railroad.

Ibex.

A five-stamp mill with this name is located almost on the boundary line between San Bernardino and Inyo Counties, on the east side of Death Valley, six miles northwesterly from Saratoga Springs, and thirteen miles westerly from the Amargosa Borax Works. It has been running occasionally during the past two years on ore from a mine of the same name. That it is not run constantly is owing to a lack of fuel. The mine and mill are owned by a Chicago company. [This property must not be confounded with the Ibex Gold Mines located near Ibex Station, on the Atlantic and Pacific Railroad, nine miles west of Needles and the Colorado River.]

Rincon.

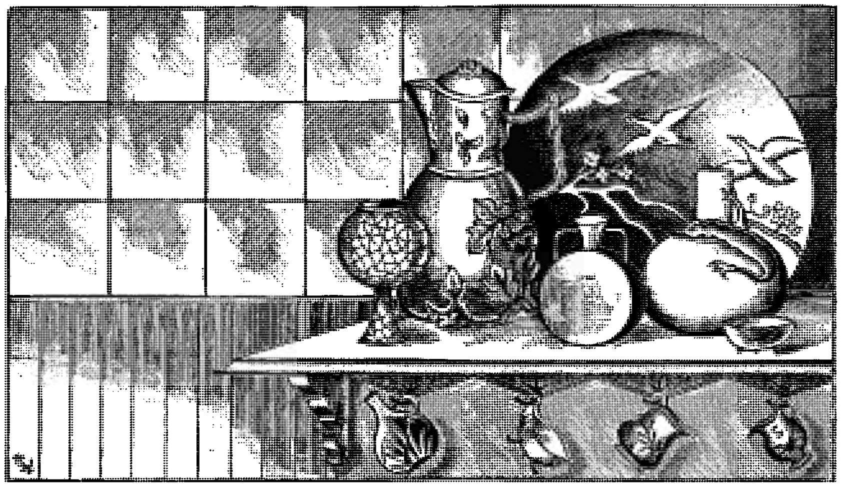
This ten-stamp mill was built upon the banks of the Colorado River, about fifty miles below The Needles, in 1887. It ran but a short time, and is idle at present.

Resting Springs and Tecopa

Are both situated near the line that divides California from Nevada. At the place first named there is a ten-stamp mill, and at the second three water Jacket furnaces. This machinery was kept in operation for several years; but in 1882 the lack of fuel caused a suspension. Since that time no work has been done. Constant prospecting of the mines is going on, however.

POTTERY.

By Linna Irelan.



The expression "Pottery" embraces a large scope and covers a wide field; it will therefore be impossible to do entire justice to the subject in a short article. The following will consequently be in reality merely a sketchy description of pottery and its decoration. It must be impressed upon the mind that "pottery" is simply a general name for articles made or modeled from clay and baked. It may be divided into two distinct classes: *terra cotta earthenware* and *porcelain*. The former includes anything in the shape of vessels made of clay, beginning with the cheap and unassuming common flower pot to the most elaborate and gorgeous majolica. The second class, *porcelain*, includes stoneware, which is, in reality, a porcelain of inferior quality, and reaches to the heights of all celebrated porcelains of ancient and modern times. Pottery is classed as *hard* or *soft*, according to the composition, and to the degree of heat which it is exposed to during the process of firing. Common earthenware articles, such as flower pots, cooking utensils, drain pipes, etc., are soft, their characteristics being a softness of the paste or clay, and their ready fusibility if exposed to too high a degree of heat in the furnace or kiln. Softness can easily be recognized by scratching the paste with a sharp instrument, when fine dust will readily crumble off. The so called soft wares are formed into four classes: the unglazed, the lustrous, the glazed, and the enameled. The first three named include the pottery of ancient as well as that of modern times of different manufacture. The latter—the enameled—is covered with enamel composed of feldspathic stone, or quartzose sand, and oxides of tin and lead. This latter class can be decorated in a highly artistic manner.

Among the unglazed pottery we find the common drain pipe, as well as the celebrated delicate terra cotta of Copenhagen, or the elaborate bisques. The glazed ware includes the pretty brown yellow-lined Bunzlau ware for kitchen use, as well as the famous Doulton, Sèvres, or Meissen, which latter is known by English-speaking nations as Dresden china.

Porcelain has the same characteristics as stoneware, but is of a higher grade, and translucent. As stated before, stoneware is really porcelain of an inferior class. Both have a very high glaze, but can be used unglazed, because they are impervious to moisture. They are both baked at a very much greater heat than earthenware, although some of the fine earthenwares manufactured at the present time require greater heat than formerly, graduating to different degrees, according to the difference in the ware. By carefully comparing broken pieces of the different wares, the layman can easily make a study of the different characteristics, which will prove more instructive than any description. In specimens of the wares belonging to class first, the glaze tells entirely distinct from the body or paste. In class second, it tells as one with the body, so to say, is melted into it.

It has proven a fruitless task to locate the origin of pottery. Chinese traditions teach us that the art of manufacturing pottery was a science with that nation as far back as 2000 B. C. From that period until about 202 B. C., only earthenware was made, but no porcelain. There is hardly any doubt that the Chinese should be considered the inventors of porcelain, and that the expression "China," instead of porcelain, comes from that source; while "porcelain" is derived from the Italian word porcellana, so called after a shell of a beautiful gloss and whiteness (Lypræa porcellana), which the porcelain resembles, and which it was supposed to be made of on account of its fineness and whiteness.

The *classification* of pottery has always been a matter of difficulty, and is necessarily, in spite of the most careful attempts, imperfect to a certain degree, as its origin dates too far back, and dates are too uncertain to complete any work on pottery, etc., without some unavoidable errors occurring.

M. Brongniart, in his "Traité des Arts Céramiques," Paris, 1854, has classified pottery and porcelain, firstly, according to the characteristics derived from the paste, and secondly, as derived from the glaze. His classification is about as follows:

1. Soft pottery, easily fusible:
    - (*a*) Biscuit.—Simple baked clay, porous, and without gloss. Example: a common modern flower pot.
    - (*b*) Glossy.—Fine clay covered with an almost imperceptible vitreous glaze. Example: most Greek vases.
    - (*c*) Glazed.—Clay covered with a perceptible coating of glass. Example: common white earthenware plates.
    - (*d*) Enameled.—Clay covered with a vitreous coating, made opaque by white oxide of tin. Example: Italian majolica.
2. Stoneware, very hard and infusible:
    - (*a*) Very siliceous clay covered with a lead vitreous glaze. Example: old gray Flemish ware.
    - (*b*) Siliceous clay covered with a salt glaze. Example: a modern brown ginger-beer bottle.
3. Porcelain, white, semi-transparent, and only fused at a high temperature:
    - (*a*) Hard Porcelain.—Natural kaolinic clay covered with a feldspar glaze. Example: porcelain of China and Japan.
    - (*b*) Soft Porcelain.—Artificial paste covered with a lead vitreous glaze. Example: early Sèvres porcelain.

This classification appears incomplete, which is unavoidable, as some pottery really belongs to two classes; for example, Italian majolica, which is enameled and glazed at the same time.

M. Salvétat amends M. Brongniart's classification by making two very complete divisions.

First, *unglazed* or *simple* pottery; second, *glazed* or *composite* pottery. Each of these divisions is again divided into *opaque* and *translucent*. In opaque potteries there are many very distinct differences. First, the color varies greatly; some are *soft*, some *hard*, and others again *very hard*. These latter form the gradation between soft and translucent pottery. The difference in the temperature forms in some cases the difference in the potteries, so that sometimes the same composition of paste may, at varied degrees of heat, offer the characteristics of all distinct potteries. All translucent potteries have some characteristics in common. They are always very hard, and generally perfectly white.

Porcelain may, simplified, be divided thus:

1. Porcelain—Hard paste.
2. Porcelain—Naturally soft.
3. Porcelain—Artificially soft.

If the paste of hard porcelain is only slightly baked (French: *faible dégourdi*) it is *soft*; when much more baked (French: *très fort dégourdi*), it is, like some earthenware, a hard pottery. When the temperature is just below that which is necessary to soften pegmatite, it becomes stoneware, and last, at a temperature of 1,500 degrees to 1,600 degrees Centigrade (blue white heat), we have procelain, the hardest of all potteries.

To make it an easier task for the layman to grasp the meaning of the different technical terms pertaining to a sketch on pottery, it may be well to give an explanatory schedule of the words used. The simplest manner of doing this will be to arrange an alphabetical list, which is the easiest way to look for reference in pursuing this article.

Adobe—Sun-dried bricks.

Albany dip—A common clay found near Albany, New York. Used in this country as a black glaze for stoneware.

Argil—Clay or potter's earth.

Barbotine—Thin slip of paste.

Biscuit or Bisque (French)—Term applied to porcelain before it is glazed and when it has no gloss. (German: Matt.) It is porous to a certain degree.

Blunger—A wooden blade used for mixing clay.

Bone—Beef bones used to make bone phosphate porcelain.

Boracic acid—Mostly derived from borax. Borate of soda, a compound of boric acid and soda. Also biborate of lime.

Camaïeu monochrome—Painting in two colors.

Céladon—A delicate grayish-green blue; also the name of a glaze on eastern porcelain.

Céramics or Kéramics—Term given to pottery, derived from the Greek.

China—Porcelain. French: porcelaine. German: porzellan.

Ciment (French)—By potters called pitchers. Means quartz, sand, calcined flints, calcined bones, chalk, baked clay, or paste, well pulverized.

Clay—Body for making paste.

Craze—Cracking or crackling of the glaze or paint, which is due to the expansion of glaze over the paste. First made by the Chinese and highly valued. Much sought for by collectors.

Dur—French for hard.

Delft—Delft ware, made in Holland, in the town of Delft. It is a fine earthenware painted and glazed.

Earthenware—French: fayence.

Earth-alkali—Feldspar and other natural glazes; also artificial ones, classed lime-glass glazes. Feldspar is considered a natural glass. Lime, sand (silica) are added as needed. At Sèvres a rock (pegmatite) consisting of a natural mixture of quartz (silica) and feldspar is used.

Eggshell—A thin, exquisitely delicate white porcelain highly prized in China.

Egyptian—Pottery made in ancient times in Egypt.

Email—French for enamel.

Enamel—An opaque vitrifiable composition used for coating pottery. Also enamel colors.

Engobe—A thin layer of paste; a slip.

Fat-oil—The fatty, thick surface of turpentine.

Faïence (fayence)—French for earthenware.

Feldspar, Feldspath—A mineral consisting of silica, alumina, and potash.

Fluorspar (not feldspar)—Very fusible. Used for glazing.

Flux—Any substance or mixture used to promote the fusion of metals or minerals, as alkalies, borax, etc.

Fusible—Capable of being melted or liquified. A coating or thin cover of pottery.

Glaze—To render it impervious to liquids.

Gloss-oven—A kiln in which glazes are baked.

Grounding—Covering pottery with a tint or color. Used in china painting.

Hard (French: dur)—Difficult to fuse or melt. Also means in pottery that it cannot be scratched with a knife or sharp instrument.

Jigger—A wheel used for making flat pieces.

Kaolin—Decomposed feldspar or porcelain clay, from decomposition of granite rocks. (Chinese: kao-lin.)

Kaolin (French)—German, porzellan-erde; porcelain clay.

Kiln—A furnace employed to bake or fire pottery.

Lustres—Metallic, iridescent colors.

Lustrous (French: lustre)—A slight varnish put on pottery.

Majolica—Italian soft, enameled pottery.

Opaque—Not transparent.

Paste (French: pâte)—Body or clay mass.

Pegmatite—A variety of granite; called also graphic granite.

Pitchers—Baked ware finely pulverized. (French: ciment.)

Plumbiferous—With lead.

Plague (French)—Flat or slightly curved surface, round or other shape, without a bottom rim or base.

Potting—Refers to vessels as having been potted, or well potted, that is, well manufactured.

Putois (English: dabbler)—A brush used for tinting or laying on grounding colors in China painting.

Pressing—Modelling ware on a jigger.

Refractory—Not readily yielding to heat; hard to soften or melt.

Rib—An instrument for shaping ware made on a jigger.

Ripening, or tempering, is really a process of fermenting or rotting of the clay or paste, which is exposed to the weather and in many cases permitted to lie for many years.

Rouge flammé—French for a red which is derived from copper and has bluish tones.

Sèvres—A famous and high priced porcelain, made at Sèvres, in France.

Silica—Silicic acid. Silica—Quartz, sand, flints. Silicic—Alkali.

Silicate—A salt composed of silicic acid and a base.

Seggars—Boxes of hard pottery, used to place valuable wares in ready for the firing furnace. They are made to stand intense heat.

Slapping—A process for rendering clay homogeneous.

Slip—A thin layer of paste.

Slugs—A piece of sandy clay used in baking stoneware.

Soft—Referring to pottery or porcelain which can easily be scratched with a knife; fusible.

Staniferous—With tin.

Stoneware—Hard pottery, glazed with salt.

Terra cotta—Fired or baked clay.

Throwing—Means fashioning or shaping on the wheel.

Underglaze—Used in regard to painting on pottery before the glaze has been put on.

Unglazed—Bodies or paste without glaze.

Vitrifiable paints—Coloring matter mixed with flux.

Wedging—Treading or kneading the clay.

Wedgwood—A celebrated English porcelain, named after the inventor, Josiah Wedgwood.

Worcester—Celebrated English porcelain, so called Royal Worcester.

HISTORY OF SOME CELEBRATED PORCELAIN.

Meissen or Dresden China.

In 1704 Johann Friedrich Böttger, a chemist by occupation and a genius, gave Elector Augustus the Strong, of Saxony, who was noted for his great extravagance, the impression that he could find the philosopher's stone. He was, therefore, detailed by the Elector and had rooms in the Albrechtsburg, a castle in the little town of Meissen, on the river Elbe, assigned to him as a laboratory, where he was ordered to proceed with his researches. He did not find the sought-for philosopher's stone, but succeeded in producing a red stoneware, which was very hard and capable of standing intense heat. He was kept in close confinement and perfected his invention, assisted by Walter von Tschirnhauszen, until he had succeeded in making fine white porcelain of excellent quality. He continued improving it until his death in 1719. Before his death he had succeeded in finding the kaolin which made his porcelain perfect. His kaolin was found at Aue, in the Erzgebirge (Ore Mountains), of Saxony.

The famous gilding of the early Dresden porcelain, as well as the celebrated Lasur-blue, have been kept secret; and although the inspecting of the factory is free to the public at the present time, it is said that only the head men, or man rather, are familiar with its preparation.

Specimens of Meissen China are preserved in the Japanese palace in Dresden, where they are shown in all stages, from the first teapot of red stoneware made for the Countess Kosel, to the famous bust of a queen, whose head is surmounted by a delicate lace veil made of porcelain fine as a cobweb, which shows the ware in its perfection.

In 1710 the factory proper was established in the Albrechtsburg, but as the beautiful castle was threatened with destruction in consequence of the continual enlarging of the works, it was removed to a new and more commodious building in 1863.

The earlier productions of Meissen were not always marked, but later on every piece was marked, and at the present time no piece is put up for sale without its mark of the two crossed swords. The rule is strictly observed that on any piece that has the slightest flaw the mark is scratched through the center, which testifies to its imperfection and makes it easy for the purchaser to see whether he receives the value of his money, as Meissen porcelain is very expensive.

The first mark used were the interwoven letters, A. R. (Augustus Rex, the Elector, had by this time been made King of Poland and Saxony), reserved only for ware for royal use. Articles for sale were in the beginning marked with a snake twined around a stick, but from 1721 the two crossed swords were the general mark used, sometimes accompanied by a dot or star, according to the period of manufacture. There are also different numbers on each piece, which have a meaning of their own. On undecorated wares the two swords never appear without a scratch in the glaze above them, to prevent such wares which were afterwards decorated by outsiders from being sold as Meissen-painted.

Meissen porcelain is generally painted under glaze.

Among the most popular patterns for general use may be mentioned the "onion pattern," which is a variety of onions executed in conventional style, blue on white ground. Entire sets, from the stately centerpiece and handsome lamp to the tiny pepper box are manufactured with this decoration, and so popular are they, that even the "second choice"—that is, pieces with flaws, sometimes almost invisible—are difficult to obtain; these are sold cheaper, and often have to be spoken for months ahead.

Another favorite design is the "mille fleurs" pattern, which consists of tiny flowers strewed in "all over" design over white ground. These little blossoms are exquisitely done, and articles thus decorated have a most dainty look.

These are only a few of the many decorations used; a more elaborate description is excluded for want of space.

It may be mentioned that Meissen, at the present time, produces very fine porcelain, which, not belonging to the royal factory, has, of course, not its mark, but is stamped with the word "Meissen." The large, handsome Meissen parlor stoves, made of fine tiles, have also added to the world renown of this little town.

The cradle of Meissen porcelain, the Albrechtsburg, has since been renovated and restored to its former beauty, and is now one of the residences of Saxony's king.

In spite of the great precautions used, which pledged the workmen to secrecy and silence, a great deal of spurious ware was thrown upon the market. Not many years ago a number of workmen were discovered who had workrooms and kilns under ground, where they manufactured goods at night, and had succeeded in selling a great deal before their exposure.

One of the workmen, employed in the early times of the manufactory of porcelain, escaped in 1720 and made his way to Vienna, where, in due time, fine porcelain was made. It gained its greatest height there during the reign of Maria Theresa. The Austrian Government suspended the manufacture in 1864.

At the present time large factories exist in Bohemia. Next to Meissen porcelain in Germany comes that of Berlin. It was made first in that city in 1751, but was not of best quality until Frederick the Great removed some of the Meissen workmen to Berlin. He also had the kaolinic clay from Aue, which Meissen so far had monopolized, brought to his factories, and very fine porcelain was made and is being made there at the present time.

There are a great many more porcelains of German manufacture, but the most renowned are the aforementioned.

England has produced porcelain of high quality, although for a long time it had no particular distinction from that made in other places. This was a soft ware. About the year 1800 Josiah Spode succeeded in bringing a new kind to perfection—*bone phosphate porcelain*. This is the ware now manufacted in England. *Bone* is a prominent factor in the manufacture of English porcelain. The phosphoric acid of bone diffuses into the materials, and forms them into a translucent enamel, which does not lose its form or sink as easily as hard porcelain. Therefore large kilnsful can be baked without much risk to the manufacturer.

America and Ireland furnish most of the beef bones, those of other animals, such as pigs or horses, imparting an undesired color to the paste.

No definite dates can be given as to the infancy of English porcelain; the beginning of its manufacture is located about 1740 to 1743.

In 1745 the factories of porcelain in Chelsea were in good working order, and important results were achieved. Chelsea has a tint of its own—a beautiful deep claret red. Another popular tint was *bleu du roi*, used as a flat tint, surrounding painted medallions or panels on white ground. Gilding was also applied elaborately in different styles.

Among other English porcelains of the eighteenth century rank *Bow* porcelain, which was made at Bow from a clay imported from America, and was rather hard. Derby porcelain was made as early as 1750. It is elaborate, somewhat in the Meissen style; the underglaze blue ware particularly fine. Different marks were used; for example, *D* with an *anchor*, and *D* surmounted by a *crown*. .

The year 1751 brings the Worcester porcelain made by Dr. Wall, a physician and chemist. The early wares were very artistic, chiefly copies of the Nanking and Japanese styles. George III gave the factory the title "The Royal Porcelain Works." Among the different marks used a "W" is the earliest, also a crescent. The modern wares of Worcester are very beautiful and delicate, the "*pâte sur pâte*" (paste on paste) being very skillfully applied. Its name at the present time is "Royal Worcester," and it is just now very popular. Among other famous English wares are the *Minton*, *Doulton*, and *Wedgewood*. Doulton porcelain is made at Lambeth; it is very beautiful, and brilliantly yet daintily decorated. Minton and Wedgewood are also beautiful styles and would require a most extensive description, being much varied in style and decoration, some being most exquisite.

The manufacture of French porcelain dates back to about 1664; it was soft ware.

The most famous and costly French porcelain is Sèvres, called so after the place where it is made. Up to 1770 this was soft; after that period hard Sèvres was manufactured. The earlier wares were made at Rouen and St. Cloud. The St. Cloud was in imitation of Chinese goods. Two workmen, brothers Dubois, escaped from the factory in St. Cloud to Chantilly; afterwards they went to Vincennes and proceeded to make porcelain. Not being successful, it devolved upon the Marquise de Pompadour to bring the manufacture of French porcelain to a point of success. Modeled flowers of great beauty were produced at Vincennes, which cost enormous sums. Remnants of these wonderfully formed flowers are preserved at the Musée Céramique.

Great rivalry sprung up between the factories of Meissen and Vincennes. In the latter place the workmen were kept as jealously confined as their fellow-workers of Meissen.

The year 1754 saw the porcelain in its perfection, and the buildings at Vincennes being found insufficient, a large edifice was erected at Sèvres, whence the factory was removed in 1756. In 1760 Louis XV bought the establishment, and retained M. Boileau as Director. The King and Madame de Pompadour took the greatest personal interest in it, and visited it once a week. The artists and other employés were kept in superior style, and all opportunities for amusement were afforded them, under which happy circumstances large amounts of superb ware were produced, and the sales of Sèvres grew to such magnitude that it was difficult to fill all the orders. As yet, though, nothing but "pâte tendre" (soft paste) had been made, although hard paste had been made for many years in Meissen.

The great obstacle to the making of hard porcelain was the lack of kaolin, as the latter substance within reach resulted in coloring the paste gray. By chance a lady, Madame Darnet, happened to discover kaolin at St. Yrieix, near Limoges, where it is found in quarries in great abundance and superior quality, accompanied by the indispensable perfectly white feldspar.

In 1769 hard porcelain was produced at Sèvres, but was not equal to the creamy softness of coloring and artistic beauty of painting of the soft paste ware, nor did it have the deep glaze. Both kinds, however, were manufactured until 1804.

Napoleon I also took great interest in Sèvres ware, and frequently made presents of specimens.

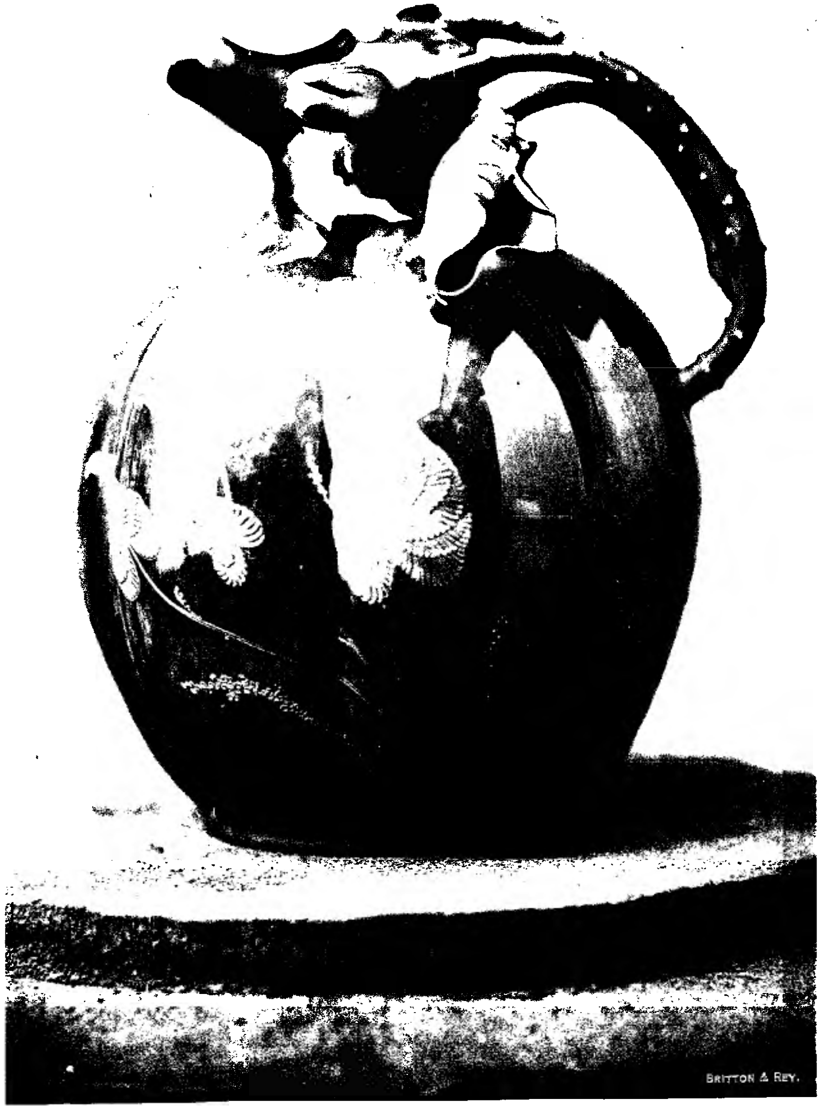
M. Brongniart, an eminent geologist and chemist, was for nearly fifty years Director of the works. He was also the author of "Traité des Arts Céramiques." He remained Director up to his death in 1847.

A beautiful rose tint, called "rose Dubarry," is peculiar to Sèvres, also "bleu de roi" and "bleu turquoise." Sèvres is sold for fabulous prices.

The marks are numerous, commencing with the Royal L in blue. The artists mostly added their monogram. Tables have been made of the marks according to the period of manufacture, too lengthy, however, for this article.

The Limoges ware is made at Limoges, in France, and is very famous. The ware is lead-glazed earthenware of more or less hard body, and the decoration peculiar to it is called *slip painting*. The coloring matter is mixed with thin paste and used with bristle brushes, which enables the artists to apply the paints like oil colors, in this manner giving body to the decoration, while the transparent lead-glaze, often united with borax, adds great depth and beauty to the colors. Borax improves the colors much, particularly the blues. The method of slip painting has been improved upon at Limoges, it having been a style of decoration used in the earliest times. The slip is a strip of paste, which must be of exactly

LAMP. AMERICAN ART FAYENCE, GREENPOINT, NEW YORK.
Height, 57 inches; circumference, 35 inches.



AMERICAN BELLEEK JUG.

the same composition as the article which it is to be used on. The same condition refers to the paints, which must in composition correspond with the slip, to prevent any cracking. An alkaline glaze is put over the whole. This transparent glaze lends great beauty to the colors. There are differences in the slip and glazes used in different factories, and great secrecy is practiced regarding them. The works at Limoges are very extensive, over five thousand artists and workmen being employed.

The kaolin which is found at St. Yrieix, is very superior and is exported even to America. The pegmatite used is also found near by at Chanteloube.

Belleek, Ireland, produces a very fine porcelain, belonging to the eggshell, which is much decorated in relief.

Very exquisite work of extreme delicacy is made at Geneva, Switzerland, and called Geneva ware. Its decoration is in the style of the Limoges, and has a deep glaze over rich, soft coloring. The *Geneva* ware is ornamented with slip painting and modeled flowers, while the *Swiss* ware has a style of decoration of its own, which looks like enameled jewelry or mosaics, slightly raised and covered with a deep glaze.

MANUFACTURE.

In America hard porcelain is manufactured, and, as will be seen in the article on clays, all the materials necessary are found in this country. About 1825 Wm. Ellis Tucker commenced making it in Philadelphia. At the present time factories are producing hard porcelain in various parts of the United States—at Trenton, New Jersey; Green Point, New York. There is no reason why, with the abundant materials available in America, pottery and porcelain should not have a great future before them. As seen in the article referred to before, California is rich in large deposits of all kinds of materials required for making numerous different wares of all grades.

Very beautiful ware, called American Belleek, is made at Trenton, New Jersey. It is a close imitation of the famous porcelain made in Belleek, Ireland. In fact, the reproduction of it is so fine that it surpasses and has taken the place of the original ware. The workmen of Irish factories, Ireland, have been brought over to Trenton, and articles of unsurpassed beauty are now made there. This porcelain belongs to the eggshell class, the principal decoration being in relief. The shapes are quaint, lotus flowers and water lilies being a favorite design, their broad leaves, deftly modeled and curved, standing out boldly, while the stems are gracefully twined to form handles. This ware has a beautiful iridescent luster, resembling the inside of a pearl shell. The coloring is rather subdued, yet rich, and gold, burnished, and matt is much used.

A special mention should be made of the wares made at Cincinnati. Miss Louise McLaughlin, the author of a practical manual on china painting, has, after numerous experiments, conducted with greatest patience and perseverance, succeeded in making a ware which closely resembles the famous Limoges. After many unsuccessful attempts, made in various parts of Europe, to imitate Limoges Faïence, it has devolved upon an American woman to solve the difficult problem. Thanks to the persistent application to her task, she overcame all difficulties, and has produced articles of wonderful beauty. This ware is decorated in the Limoges slip-painted style, with bold effect, warm coloring of great strength, and much artistic feeling. These articles have a harder body and glaze than the original Limoges. One of her large vases, exhibited in this State, was decorated in bas relief: a large, red fish, caught in a net. The whole piece was executed boldly, showing great breadth.

WORK OF LOUISE M. McLAUGHLIN.

In 1878 specimens of this work were sent to the Paris Exposition. About the same time Miss McLaughlin achieved her first success in painting blue underglaze on white ware.* She has since published another book, "Pottery Decoration Under the Glaze." The lady has steadily continued her researches, and many works of art and great beauty owe their existence to the intelligent and deft fingers of this pioneer of American decorative pottery, destined to associate her name forever with this industry.

(The first notable exhibition of Cincinnati decorated pottery was held in May, 1875, at the old Elm Street Exposition Building. This has been followed by larger exhibitions.)

In making pottery naturally the principal ingredient is the clay, which is used in its natural state for the coarsest ware, and is called body or paste (French: pâte). The primitive way of utilizing it is shown in the sun-dried vessels, tiles, or adobe bricks made in ancient times in Egypt and Assyria, and even now in Mexico and other tropical countries. These sun-dried articles can only be used in a dry state. The baking or firing only renders them insoluble for liquids. The degree of temperature which the ware has to be exposed to in the baking depends on the composition of the paste, for which clay serves as a base.

C. A. Janvier has arranged tables which show the composition and proportions of different wares, and it might be appropriate to insert a copy of these tables in this article. (See pages 258–261.)

The wares to be produced depend upon the composition of the ingredients, the clay which they are mixed with, and the temperature which they are baked in. Paste may be called modified silica. If the paste or body contains but very little iron, lime, etc., it will bear a high temperature, yet not melt. Much iron, lime, and other impurities flux the body at a low heat, so that it will melt into a shapeless mass. The alkalies which the clay mass generally contains, such as feldspar powder and dust, do not influence it at a low degree of heat, but they will, aided by lime, act as very strong fluxes, if the heat is sufficient to melt the feldspar.

The plasticity of the clay is of great importance, as the modeling of the ware depends upon this quality.

Plastic clays are called fat or long; the less plastic, short. If the clay is too plastic, the ware will shrink too much in the baking and lose its shape, therefore ingredients are introduced which are non-plastic and unshrinkable. Potters call these "pitchers" (French: ciment); they may be sand, calcined bones, chalk, baked clay, or porcelain pulverized, calcined flints, even sawdust, which latter, however, burns out and leaves spaces in the clay. For objects of more or less elaborate form, most careful calculations have to be made to allow for shrinkage; for simple pieces, such as plates, this is not of much importance.

---

* In 1879–1880 she produced her "Ali Baba" vase, said to be the largest piece potted in the United States. She presented this vase to the Women's Art Museum Association of Cincinnati. Other ladies and some gentlemen have followed Miss McLaughlin's example, and wares of great merit are being brought forth.

After the clay which is to be used for very fine wares has been dug up, it is dried, and after having been broken up all foreign bodies are carefully removed. It is then put into a "blunger." Very pure water is added and the mixture worked with paddles attached to a shaft, until it has the consistency of cream. After water and clay are thoroughly mixed it becomes "slip" and is now drawn off and run through a series of strainers or sieves, which gradully become finer meshed until it finally passes through one of exceeding fineness. Another process consists of washing the mixture down through a succession of tanks, in which the heavier parts sink to the bottom.

Whatever "pitchers" are to be added must be pulverized as finely as possible. In China and Japan this is done very primitively, in Europe and America by excellent machinery. (In this country, Alsign's dry grinding cylinder mill.) The potter tests the pulverized material with his teeth or rubs it between his fingers.

The clays and pitchers thus prepared can now be mixed either in a powdered state, or, which is more usual, each ingredient has a certain proportion of water added, so that a quart of one will be equal to a quart of the other. After this they are generally mixed in a machine similar to the one before mentioned. Water is added until the liquid is like cream and can pass through the finest gauze. The slip is now dried, as it must not be left in a liquid state, in which the heavier parts would sink to the bottom; in this state, also, the slip would not be plastic. Various methods of drying the slip are employed: exposure by air, or by absorbing it in plaster boxes, etc. An English firm invented an ingenious method of *straining bags*, which are used in larger potteries of Europe and America.

The paste now has to be rendered as homogeneous as possible in texture, and all air bubbles must be removed.

One method of doing this is very old: kneading it with hands or feet, called "treading." After placing the tray on a tiled floor, the workman walks with bare feet from the outer line to the center, spirally, until the clay is sufficiently "treaded." Another process is putting the paste into a mill, called a "wedging mill," which consists of a cylinder having knife blades inserted in the sides and in an axis in the middle, arranged in such a manner as to cut the clay and force it into a spiral. This process, after having been repeated several times, is considered more effective than the "treading." Yet even this is not sufficient for very fine wares, such as porcelain. For this ware, the clay, just before using, is treated to "slapping." A very strong man raises a quantity of about fifty pounds and cuts it through with a brass wire. He then throws the cut-off piece with all his strength on the other part, and repeats this until the paste is perfectly smooth and close where it is cut. After this it is pounded with a mallet. If this has been thoroughly done, the blending must be so thorough that any coloring matter added to it will be equally mingled through the whole. By this operation the air is also driven out, which is most important, as air bubbles expand in the baking and ruin the ware. The process of wedging has almost entirely superseded that of slapping, but for the very finest wares nothing seems to answer as well as the hand work.

Frequently the clays and pastes are allowed to "ripen," that is, they are left in the open air exposed to the weather, or put in pits or cellars to temper, and kept moist. Sometimes even putrid water is added to assist the mass to ferment and putrefy. The ripening is often extended to many years, particularly in China.

The coarser wares do not undergo all these processes, treading or wedging alone being considered sufficient. The finest ware receives the most elaborate treatment.

The paste being sufficiently prepared, it is ready for shaping or modeling. The most primitive way is shaping it with the hands. This is yet done in Spain, where huge jars are thus made. The famous Japanese Banko ware is also pinched and patted into pretty shapes.

The ordinary way, however, is making pottery on the "potter's wheel," which was employed for this purpose at least four thousand years ago. The potter's wheel varies in form according to the power used for moving it.

Differently formed articles require different processes of shaping, such as *throwing*, *pressing*, and *casting*.

Throwing is employed for hollow vessels. A piece of clay or paste is placed on the small platform of the wheel, which rapidly revolves. The potter then shapes this into the object desired, using his fingers and a wet sponge, maybe also some simple modeling tools. He first forms a cone, which he forces again into a heap. He then thrusts his thumbs in and hollows it out, running it up into a sort of hollow cone; then finishes it off properly with hands, sponge, and tools. This seems all very simple, yet is very difficult. Good throwers are trained from boyhood up. When the piece is finished he cuts it away from the top of the wheel by slipping a brass wire under it.

Fine wares are often finished off on the outside by another man, who uses for this purpose a *lathe*, called potter's lathe. It is similar to the ordinary turning lathe.

Flat pieces, plates, etc., are made by *pressing*. The *presser* takes a piece of paste, expels the air by beating and slapping, and rolls or beats it into a thin layer. Sometimes a sort of rolling-pin is used, the presser placing the layer of paste *outside* the mold. Fine wares have to be handled with great care in lifting the paste; generally it is rolled out in soft leather. Now the paste on the mold is placed on the head of the wheel, here called *jigger*, consisting of a spindle resting on its point, which is provided with a head to place the mold on. The wheel may be turned by a treadle used by the workmen, or by machinery. The jigger is moved by the same means, sometimes a boy turning it. The process of pressing is repeated several times—no less than twice. After drying them enough to have the proper consistency, the plates, etc., are taken off, smoothed inside, and finished off as finely as desired.

Large pieces, and also small ones, are now mostly made in molds of plaster of Paris, which gives the shape, and sometimes ornaments, to the outside half of the piece. To make a pitcher, for example, the potter spreads a thin layer of paste inside the hollow mold and presses it carefully into it with a wet sponge, taking care to keep it even in thickness. The same is done to the other half. Then the two halves and the bottom piece are fastened strongly together, the place where they are joined wetted with slip and smoothed down. Plaster molds rapidly absolve the surplus moisture, when the paste will be found dry enough to permit the pitcher to be lifted out and put away to dry. In spite of the greatest care taken in joining the two halves, the line where they meet will show after baking, so that in fine wares it is of great importance where this line is to be. This mark is turned off by a lathe.

The plaster molds are of rather recent date, and particularly suited for the purpose, as they absorb the water so rapidly. They have, therefore, almost entirely taken the place of baked clay or metal molds.

Some ornaments, handles, and spouts are molded separately and fastened to the vessel with slip. Ornamented handles are pressed in molds, and must be carefully handled, not to become bent or distorted. For plain round or flat handles the paste is forced in long strips through holes of the desired shape, and cut up to suit, after which they are fastened with slip.

Very thin ware is made in a sort of double molds, the inner of which may be in one, two, or even more pieces, carefully fitted together, and held in place by the outer mold. Into this mold very thin slip-paste is poured; this soon adheres to the absorbent plaster and thickens rapidly. When it is considered of the proper thickness, the superfluous slip is poured out. After the paste has dried and contracted, the mold is carefully taken off. To compress the thin layer of paste and give it sufficient consistency compressed air is frequently forced into the molds. This process prevents very thin vessels from falling to pieces.

Pieces which require great neatness and delicacy are best executed by this method; very thin cups are made by it in molds and the feet put on afterwards. Handles also are sometimes hollow and made this way by slip, to be used for eggshell porcelain.

For basket or openwork ware the spaces are cut out of the solidly molded article very skillfully by hand, by the workmen, or rather by clever workwomen. A very delicate process is the making of vessels double, with the outer part cut into openwork designs. In this case the inner part is made first, then the outer part or shell placed on it, and joined by slip at points of contact. Care must be taken to have both pastes of equal consistency, so they will contract equally. The desired pattern is then cut into the outer shell, refraining carefully from letting the knife touch the inner part.

Lacework is in most cases made by dipping the lace, of the desired shape and pattern, into slip, after which it is draped upon the article before baking. The lace proper burns away in the baking, and, on account of shrinkage, leaves the slip-lacework on the article more delicate of fiber than the original lace. The workwomen who mostly perform these delicate tasks, also ornament pieces by *dragging* or *dropping* the paste, mixed to the proper consistency, over the vessel, as the confectioner ornaments cakes.

Large potteries employ their own moldmakers; for fine ware, good artists, and often famous sculptors.

The celebrated eggshell porcelain is made by enameling the pieces on the inside, and after baking them, removing the paste by grinding, leaving only the enamel. Then another coat of thin enamel is placed on the outside.

Bricks, tiles, drain-pipes, and ornaments for architectural purposes are generally molded or cast by machinery.

Many more processes could be added and more minutely described, as they vary in different countries according to wares and machinery employed. Many machines for perfecting the manufacture of pottery are used in Europe and America. The easiest way and the most instructive is to watch the various processes of potting in a pottery; this is as practicable as interesting, and teaches more than the most elaborate description.

After the potter's task is finished, the moist pieces are taken to be dried. They are placed on plaster shelves in the drying stove or closet, and exposed to a temperature of about 125 degrees Fahrenheit, beginning with 90 degrees, until they become hard enough to be handled. They are then baked. The ware may be baked unglazed (biscuit), or it may be baked slightly and then glazed; or it can be glazed and baked at one time.

Glazing means to cover the articles with a thin coat of natural or artificial glass. The composition of glazes must vary in fusibility, according to the ware which it is to cover. To prevent the cracking (technical expression, "crazing") of the glazes, they must expand or contract in proportion with the ware.*

It is generally easier to glaze very siliceous wares than those containing a large proportion of alumina. The materials for composing glazes most used are feldspar, kaolin, quartz, sand, lime, borax, boracic acid, sea salt, potash and soda, fluorspar, ochers, oxides of lead, of manganese, cobalt of iron, and oxide of tin. The best glazes have borax and some alkali added as a flux; in this case the proportion of lead is reduced. Glazes which contain much lead are easily scratched and decomposed by acids; they are therefore dangerous if used for cooking utensils. Without entering more minutely into the composition of various glazes, which, in numerous cases, are secrets of the manufacturers using them, a general description of the process of applying them may be made. The ingredients for ordinary glazes are ground to a fine powder (the finer this is the more lustrous the glaze); water is added to the consistency of cream. This composition, with the addition of a little vinegar to prevent a precipitation of the heavier parts, is applied without any more preparation.

Another process is *fritting*. This is a melting of different ingredients with any salt soluble in water, as borax, niter, or soda, into glass, running this into cold water and then breaking it up into fragments. This "fritt" is then pulverized, and insoluble materials added, if necessary. The ware is then dipped into this glaze liquid. After the water is absorbed by the porous ware, a thin coating of powder is left, as if the piece were powdered with sugar. Any bare spots are covered with a brush, and where the pieces came in contact with the "seggars" the glaze is wiped off. In non-porous wares other processes are employed.

The glaze is made into a thick liquid, and some of it put on, or, as needed, inside the vessel, which is moved around until the glaze covers it evenly. The glaze may also be applied with a brush, etc. In England some glazes are "dusted" on. The now glazed ware, if entirely dry, is placed in the kiln ready for *baking* or *firing*.

The proper placing or packing of the wares in the kiln is most essential, and a branch of the manufacture in itself. It requires a skillful and experienced workman, who has a task of great responsibility.

The *kilns* vary in form; some are cone-shaped, others square with arched tops, or circular buildings; some are two stories high. The most essential quality is an equally distributed heat.

Within the later years numerous improvements have been made. Instruments for measuring heat, called *pyrometers*, are used. Skillful potters, however, judge the heat by experience. They can gauge it to great exactness by placing pieces of paste within easy reach in the kiln and examining them during the process of baking. Small apertures are left in the kiln for looking into it. These are carefully closed, though, when not used.

Formerly wood was the fuel always employed for heating the kiln, now, however, charcoal, coal, coke, and even gas with regenerative stoves are employed. China and Japan use wood only.

The coarser wares are simply placed in the kilns with the fire playing directly on them. The finer wares are placed in "seggars," which are dusted with fine flint sand to prevent the pieces from adhering. The seg-

---

*One of the oldest, and said to be lost arts of the Chinese, is the crackle ware. This effect is produced by an artificial expansion of the glaze. Several methods of making this crackle ware have been published, but there is no certainty as to their being the genuine Chinese.

LARGEST VASE POTTED. AUSTRIA.
Height, 92 inches; circumference, 88 inches.

gars must be packed with great care, little props or pins, stilts, etc., of fire-clay being used to keep the articles from touching. Numerous other methods of packing kilns are in use, according to the consistency of the wares, the *soft* paste needing greatest precaution.

DECORATION.

The only method of decoration really correct and adapted to pottery or porcelain is that which is indestructible. This law, in regard to colors, demands their being derived from minerals, as any animal or vegetable matters will not bear a temperature high enough to fire pottery or porcelain. Therefore, the pigments used are necessarily *oxides* and *salts* of *metals*. Of these, not all are capable of standing the high temperature of the glazing kiln. It is, therefore, necessary to confine certain colors to overglaze decoration, as the temperature needed to fix the colors on the glazed surface is not so high as that which is required to fire the glaze. In *overglaze* painting, the pigments unite with the glaze during the process of firing, and make them as one. In *underglaze* decoration, the painting is applied to the *unglazed* ware, and the glaze put over the decoration. The ware being so far only biscuit, a mellow softness of the tints is the result, which makes the Limoges ware and that of Cincinnati so beautiful. The ground tints are blown on with an atomizer, invented for the purpose, which results in the marvelously soft, cloud-like backgrounds, which have made this ware so famous. The high glaze, which is added afterwards, only tends to subdue the tints more, without lessening their strength in the least. Great care is taken to employ only tints which harmonize, and the results are due to the truly artistic feeling of the decorators, who are real artists.

To more easily understand the different styles and methods of decoration, it must be explained that the fixed colors should be classed as *enamels* and *vitrifiable paints*.

The difference between enamel and vitrifiable colors is, that the color is not mixed with the glass, but *dissolved* in it. To use chemical expressions, enamels are silicates, borosilicates, or phosphosilicates, colored by oxides in solution. The colored glazes and most of the underglaze colors are enamels. These latter must either be prepared with the coloring matter and placed on the ware, or the materials for the enamels placed on it, and the two united in melting. In using enamels for overglaze painting, certain conditions must be observed, or they will crack and come off. Enamels can be more or less *transparent*, or they may be made quite *opaque* by adding very carefully prepared phosphate of lime, or oxides of tin or of antimony.

Paints are *vitrifiable* when the coloring matter is mixed with the flux, instead of being dissolved in it, as is the case with the enamels. Most of the colors used for overglaze painting on hard porcelain belong to this class. These colors must possess certain qualities, which are: 1. They must not chemically change in melting at a certain temperature; 2. They must firmly adhere to the article applied to; 3. They must come out of the fire glossy (this is not applicable to the "matt" or unglazed colors); 4. They must not be affected by moisture or dry atmosphere, or by gases; 5. They must expand or contract in proportion with the surface applied to. Where it is possible the colors should remain the same after firing as before, and not destroy each other when mixed. This should be the case with enamels also. As the surface on which fluxed paints are used is generally less fusible than the paints, it happens, especially with hard porcelain, that the glaze remains hard, while the paint melts at a low temperature, which causes it to form hard outlines, and even to crack or scale off. A softer or more fusible glaze, for example that of soft porcelain or faïence, will permit the paint to sink into it slightly, thus giving a very rich effect to the work, and uniting pigments and glaze so thoroughly that there is no danger of scaling. This rich, soft effect is also achieved by the mingling of color and glaze in majolica. As in the mixture of clays and glazes, the recipes for composition of fluxes and paints vary, and each manufacturer has his own special compounds. Speaking of fluxes or colors in a general way, it may be stated that flux and coloring oxides are carefully ground to an impalpable powder, this being of greatest importance to the brilliancy of color and the gloss of surface. On the average, about three parts of flux are mixed with two of coloring matter, varying, however, in proportion, according to shades desired, and also to the ware on which they are to be used. Cobalt blues and copper greens have to be subjected to a greater heat in order to bring out the full strength of the color; these are, therefore, melted with the flux first, then cooled and finely pulverized. Fluxed paints are usually put in the market in fine powder. When used they are mixed with turpentine and *fat oil*, which latter is the sticky substance gained by exposure to air of spirits of turpentine. The constant researches of chemists have resulted in bringing forth numerous new colors of greatest beauty. There are three general classes of pottery paints: *Underglaze*, or refractory, also called *gloss-oven* colors; *hard kiln*, or medium heat; and *regular kiln*, or ordinary or soft muffle heat. Underglaze colors must be prepared with regard to the pottery which they are to be used on, so no injury will be done to them by the material used for paste or glaze. The *engobe* or *slip* painting referred to before is done with underglaze or gloss-oven paints.

The colors for hard potteries have to stand such a high temperature that they are not so numerous as those used for soft ware. As the temperature becomes lower, according to the different wares, the range of colors becomes larger. After underglaze colors have been applied, the ware is subjected to a process of *hardening*, a sort of preliminary baking, which requires a red heat. The glaze is then put over it. The colors may be called *potter's* hard colors. *Decorators* generally refer to *hard kiln* or medium heat—sometimes high muffle colors—in speaking of hard fire colors. These vary little from the regular kiln colors, and are, like them, applied *over* the fired glaze, never under it.

The third class colors—*regular* or *ordinary* kiln colors, also soft muffle colors—come in tubes or in powder, for use over the glaze on porcelain, and are called porcelain paints, mineral paints, etc. Lacroix, who manufactures them so extensively, calls them "couleurs vitrifiables."

The Chinese and Japanese have rather limited lists of colors, as their knowledge of chemistry is not sufficient to produce new ones. Some of their colors, however, are famous; for example, *céladon* and *rouge flammé*, or flambé.

PAINTING.

Probably no style of painting is more popular with the amateur than porcelain painting. Why this should be seems difficult to explain, as it is decidedly not "easy," nor by any means a thankful task unless done well. Yet it appears as though no branch of art were more sinned against than porcelain painting. The only explanation may be that the average amateur desires *result*, without being compelled to undergo the tedious preliminary studies so patiently followed by the professional. It is well known that porcelain painting by many artists is looked upon as merely a *technical* industry, not an art. By the writer of this article, however, good, artistic work on porcelain is considered very difficult, as bad or indifferent work is brought out more prominently by the firing, which softens no blemish and hides no mistake. One of the greatest difficulties in porcelain painting, and particularly in overglaze work, is that the surface is not yielding, like paper or other materials used for painting. Great skill in wielding the brush is therefore required to bring forth the softness of outline so much desired in all painting. The widely cherished idea that a knowledge of drawing is not necessary for porcelain painting, and that tracing is not only perfectly legitimate, but a rather capital substitute for drawing, may have something to do with the popularity of this decoration, which is more resorted to as a pastime rather than a true study.

The first and foremost condition necessary to success in any branch of art, a knowledge of drawing, is also an absolute necessity in pottery and porcelain painting. Of course, if the student's ambition is satisfied with very moderate success, simple decorations are often executed with good effect; but where really good work is desired, the student should not expect to accomplish anything without a proper foundation, artistic training, and unceasing perseverance.

Numerous lists or "palettes" for this work are made out, according to the preference which teachers and professional decorators have for certain colors. The latter generally use those which come in powder, and prepare them according to their liking. The tube colors are ready for use and need only be rubbed with a little turpentine to make them pliable. Lacroix's tube colors are probably more used than any others. These tubes contain colors ready for painting and also for "tinting" or "grounding." These latter are prepared for grounding only and will not bear mixing with others, as they contain too much flux. English colors are also much used by artists, as well as German. Many prefer to select their palettes from different makes, choosing particular colors which they consider best, regardless of the maker. Thus, English and German decorators will use Lacroix's Rose Pompadour largely.

Ulrich's enamel paint in tubes (German: schmelzfarben) and powder, are also much used, being rich in colors and coming from the firing with a high glaze. The so called *Matt wax colors* are adapted for painting in Royal Worcester style and have a beautiful, soft effect. Another new kind are the "new Gouach colors;" also particularly adapted for Royal Worcester style of painting.

The so called Royal Dresden china colors come in tubes and porcelain pans, put up like moist water colors. They are handled like water colors on glazed porcelain, which has previously been covered with a medium specially intended for the purpose. Porcelain which has been decorated with these colors is fired just as if vitrifiable colors had been used; the porcelain water colors are exceedingly rich in tone, but difficult to manage.

A special point has always been made of cautioning against the use of different colors, that is, those of different make, on the same work, as it was contended that the use of different colors side by side would result in uneven firing. Many professionals, however, claim to have achieved great success by using colors of different manufacture at their own pleasure, some even employing Lacroix paints in touching up work executed in Hancock's moist water colors. For beginners, though, it would be advisable to confine themselves to one set of colors.

Manuals for china painting give different lists of colors or "palettes," according to the preference of the authors; it is advisable, however, to observe the same rule which applies to all styles of painting; that is, the student should confine himself to as simple a "palette" as possible, as this will make the work easier and less puzzling. As porcelain paints change more or less during the process of firing, the painting must be done with the desired result in view. A certain familiarity with the colors *before* and *after* firing is therefore desirable, which can be accomplished by making sample "palettes." For this purpose a large, rather flat plate is to be divided into as many compartments as colors are to be used. Now, a little paint is to be squeezed on the "ground" surface of a glass slab and "rubbed down" with a palette knife, using a horn or ivory spatula for colors containing gold, little or no iron. Enough turpentine must be added to make it easily managed, then the compartments filled in by putting the color on thick on the outer edge, and letting it become lighter gradually, until it blends into the white porcelain. Each color must be numbered with ivory black, and a corresponding list be kept to refer to. Those who do not wish the trouble of painting a sample plate, can buy them all ready at the art dealers, as the manufacturers of colors make these plates containing all colors, both for painting and "grounding."

Complete "outfits" can be had at any art store, including the different mediums needed for the work, as turpentine, fat-oil, oil of lavender and cloves, balsam of copaiva, etc.

The actual process of painting may be described as follows: After the article to be decorated has been well cleaned, prepare it for receiving the design. This should be sketched "free hand" with a finely pointed lithographer's pencil, or a hard lead pencil. The porcelain surface will receive the latter better after having been rubbed over with a little turpentine or alcohol, the former being preferable. As soon as the surface is dry, the design can be sketched on, as lightly as possible, so the pencil lines will not soil the paint. If tracing paper has to be used, great care must be taken to use an instrument which will make the lines as delicate as possible. Tracing in itself must be done very cautiously, otherwise the design may lose much of its character.

If a "tinted" ground is desired the prepared color is laid on in a flat tint with a broad, flat brush or *putois*. After the surface has been evenly covered and allowed to remain until it has become somewhat "sticky," it is gone over with the "blender," which is held perpendicularly, "dabbing" the article lightly until an even tint is attained. Instead of the blender, a ball of cotton tied in chamois skin, linen, or raw silk can be used.

In factories and by professionals another method for laying grounds is largely practiced. The porcelain is evenly and quickly covered with "grounding oil" especially prepared for the purpose. This done, the surface is lightly dabbed with a ball of cotton tied in raw silk. When slightly "sticky" the powdered color is "dusted" on with a large brush, any superfluous powder being lightly brushed off. This method requires skillful handling.

Designs or patterns are sketched on tinted grounds as described before, and the color removed by "scraping" it off or applying mediums mixed for this purpose, for example, lampblack, balsam of copaiva, and oil of cloves. This medium is applied with a brush, and after remaining a little while on the surface it is quickly wiped off, exposing the white surface. After the color has been removed where the design is wanted, the ware may be fired, or the design painted on at once. Referring for a detailed description to works which are especially published with the view of giving instructions, it may be added that a practical course in porcelain painting is the only method of learning to conquer the many technical difficulties which accompany this particular branch of art.

After the painting is finished the article must be kept free from dust until dry, when it is ready for firing. Gilding, putting on bands or lines are special branches, and should be left for the professional decorator. Burnish gold (German: polir gold) comes dull from the kiln and is polished with burnishers. This work is generally done by women, and requires practice. Another style of gilding is done with "glanz gold," which comes bright from the kiln and needs no burnishing. This is used for cheap ware and not so lasting as burnish gold. Very effective styles of decoration are achieved by leaving the gold partly dull and partly polished.

For putting on bands or lines "whirling tables" are used. The decorator, after placing the article directly on the center of the whirling table, steadies his arm on the "rest," and, applying the brush charged with paint to the object, moves the wheel rapidly with the other hand. This requires skill and practice.

In factories fine ware generally receives several firings. Meissen or Royal Dresden articles are fired as often as six times or more. Generally speaking, all painted articles should be fired twice at least. For the first fire the work should be done in a sketchy manner, leaving the details to be worked up for the second, or, if desired, third firing. Beginners should practice considerably before having any of their work fired at all, wiping it off repeatedly, until the teacher considers it done well enough to be preserved by firing it.

FIRING.

The packing of the kiln for firing painted ware is as responsible a task as the packing of one for "green" ware, and must be done by an experienced person, as some of the colors require more heat than others. Particular care must be paid to carmine. Very fine ware is generally placed in "muffles," which are similar to the before mentioned "seggars." To prevent articles from touching, which would result in their adhering to each other on account of the glaze melting them together, little stilts or triangles of "biscuit" are used. After the kiln has been carefully packed and the proper heat attained, the process of firing can be watched through the "spy-hole." It is quite interesting to note the gradual heating of the ware: the painting turns darker as the temperature increases, becoming a reddish brown; then, as red heat is attained, a bright red, and lo! disappearing entirely as soon as white heat is reached; then gradually appearing again, turning red, reddish brown, and so on, until the different colors have returned, only brighter, and covered with transparent glaze. The fire is lowered gradually, and the kiln must be permitted to become quite cold before removing the articles.

The time necessary for firing is about three to five hours for fusible colors, underglaze colors and glazing about thirty-six. This is only taking a general average. Gold requires a higher temperature than that at which silver melts. By means of trial pieces the different degrees of heat required can easily be observed. Carmine, if not subjected to enough heat, will burn an ugly brownish hue; if overheated, an equally ugly violet.

Amateurs employ largely the portable kilns, and achieve, with great care, comparative success. In many cases gas is used, and the firing done in quite a short time. These kilns are not suited, however, to large pieces.

Referring again to an article in another part of this report, which contains the results of chemical analysis of clays and kaolins found in California adapted for the manufacture of pottery and porcelain, it is sincerely to be hoped that the facilities which this State offers, namely, large deposits of all necessary materials, will, in the near future, lead to their development, and thus lay the foundation to a new industry, which, hand in hand with art, will add to the fame of our State.

TABLES OF PASTES.

TABLES OF PASTES.

KINDS OF POTTERY.	Silica.	Alumina.	Magnesia.	Potash and Soda (not separated).		Iron.	Lime.	Water.	Carbonic Acid or Carbon.	Glazes.	Analyses Principally from Salvétat and Brongniart.
Soft Body or Paste.											
1. Peruvian	67.04	10.83	0.28	......	......	10.17	3.24	7.07	1.00	......	Scarcely baked at all; unusually low proportion of silica.
2. Madagascan	44.00	31.20	......	......	......	7.05	1.25	15.24	1.26	......	......
3. Campanian (Italo-Greek)	52.95	27.15	1.76	*	*	12.87	5.25	......	......	Sometimes lustrous	Soft, marl-body lime, probably as silicate. This is the general composition of the finest potteries of this class—very old. Sometimes with lustrous glaze, now proved to be composed of silica and alkali, with oxide of iron or lime, transparent glazes, sometimes black, probably iridium.
4. Etruscan	63.00	14.44	......	......	......	7.75	3.00	8.45	1.55	......	Many analyses of this Etruscan pottery upon great similarity, probably all made by about same recipe.
5. Roman (red) Luxembourg	54.39	24.24	1.83	......	......	10.24	9.25	......	1.68	......	......
6. Roman (gray)	61.58	25.78	3.05	......	......	4.27	2.17	2.04	0.99	......	......
7. Black, Gallic	62.22	18.36	0.47	......	......	5.71	1.17	10.56	.78	......	Not baked enough to drive out the carbon; very low heat.
8. Spain, modern	53.04	19.11	......	......	......	6.01	14.01	2.06	5.77	......	Very low heat.
9. Portugal, modern	54.02	20.00	1.45	......	......	9.76	4.76	5.97	4.04	......	Very low heat.
10. Coarse earthenware	39.50	12.00	0.20	......	......	5 35	20.00	7.30	17.50	......	These were analyzed before baking; only well dried, which accounts for the water; all lime-body.
11. Coarse earthenware	36.50	10.50	......	......	......	5.40	25.00	6.00	20.00	Tin or lead	......
12. Lucca della Robbia (Majolica)	49.65	15.50	0.17	......	......	3.70	22.40	......	8.58	Tin glaze	Lime-body; this takes tin glazes very well.
13. Delfware	49.07	16.19	0.82	......	......	2.82	18.01	......	13.09	Tin glaze	Lime-body.
14. Persian	48.54	12.05	0.30	......	......	3.14	19.25	......	16.72	Tin glaze	Lime-body; often has a borax glaze from trical.
15. Rouen	47.96	15.02	0.44	......	......	4.07	20.24	......	12.27	Tin glaze	Lime-body.
Hard Body.											
16. Pallissy	67.50	28.51	......	Trace.	......	2.05	1.52	......	......	Lead glaze	Pipe-clay or ball-clay paste. Most of his pottery had a tin glaze.
17. Henri II (F. d'Oiron)	59.10	40.24	......	......	......	......	......	......	......	Lead glaze	Ball-clay paste, with a little kaolin in it, and there is probably a little iron, etc.
18. Lunéville (terre de pipe)	67.39	16.00	1.02	Trace.	......	2.01	13.16	......	......	Lead glaze	Old fashioned French ball-clay body earthenware, often with tin glaze to make it harder.
Very Hard Body (Fine Earthenwares).											
19. Creil (France)	66.10	32.20	......	1.10	......	0.55	0.14	......	......	Boracic	Modern French flint-body; fine earthenware, made on English recipes.
20. Minton (England)	72.60	24.10	......	2.20	......	1.10	......	......	......	Boracic	Modern English flint-body; fine earthenware.
21. Wedgewood (England)	76.10	20.45	0.14	1.60	......	1.00	0.75	......	......	Boracic	Modern English flint-body; when glazed with a soft lead glaze this is much like the old C. C. ware.
Very Hard Body (Stonewares).											
22. Vauxhall (whitish)	74.00	22.04	0.17	1.06	......	2.00	0.60	......	......	Salt glaze	Iron-body.
23. Wedgewood (yellowish, unglazed)	66.49	26.00	0.16	0.20	......	6.12	1.04	......	......	......	......
24. Chinese (reddish-brown, unglazed)	62.00	22.00	Trace.	1.00	......	14.00	0.50	......	......	......	Iron paste; these soften in the heat of the hard porcelain kiln.
25. Japanese (reddish-brown, unglazed)	62.04	20.30	Trace.	Trace.	......	15.58	1.08	......	......	......	......
Very Hard Body (Porcelains).											
26. Nymphenburg (Bavaria)	72.80	18.40	0.30	0.65	1.84	2.50	3.30	......	Veilgrith	Earth alkali	Lime porcelain; no feldspar is used, but a good deal of lime. Roscoe gives passau kaolin 100; bode mais quartz 40; marble (lime) 10.
27. Meissen (Dresden)	58.50	35.10	Trace.	5.00	......	0.80	0.30	......	......	Feldspar	Brongniart and Prossel give gypsum, not marble. The alkalies come from the undecomposed feldspar in the kaolin, or from the sand. The glaze is an aluminous lime-glass.
28. Limoges	70.20	24.00	0.10	†4.30	......	0.70	0.70	......	......	......	Here is also made a hard body with a lead glaze. This is for decorative purposes.
29. Sévres	58.03	33.94	......	2.97	......	......	4.58	Trace.	Laurent	Pegmatite	......
30. China (first quality)	69.90	26.60	0.02	3.30	2.90	1.20	0.30	......	......	......	The Chinese glazes have a large proportion of lime, at least one fourth, and are more fusible than the European glazes.
31. Japan (eggshell ware)	78.763	17.847	.029	.203	1.975	.638	.213	......	Würtz	......	Washed tsiji-chu-chi, 17 p. c.; washed shiro-chu-chi, 30 p. c.
32. Japan (thick body porcelain)	74.545	19.315	.176	.566	2.832	1.916	.106	......	Würtz	......	Washed shiro-chu-chi, 50 p. c.; washed sakaimé-chu-chi, 50 p. c. These porcelains are very siliceous, and are more fusible than the European.
33. Piedmont (near Turin)	69.80	10.40	17.60	......	......	......	2.00	......	......	......	A similar porcelain is made in Spain.

---

* Either not present, or if present they will have no effect at all, the pottery being baked at too high a heat to affect them.

† Alkalies.

TABLES OF PASTES—Continued.

KINDS OF POTTERY.	Silica.	Alumina.	Magnesia.	Potash and Soda (not separated).		Iron.	Lime.	Water.	Carbonic Acid or Carbon.	Glazes.	Analyses Principally from Salvétat and Brongniart.
34. Worcester	82.00	9.10	7.40				1.30			Boracic	The old English porcelains had flint-glass glazes; the modern have borax or boric acid in the glaze. No available modern analyses.
35. Sèvres (old paste, about 1760)	74.50	2.00		2.60	1.00		15.78			Lead	Fritted body, flint-glass glaze, very soft and very brilliant. Soft porcelain will also take a lime-glass glaze.
36. Sèvres (about 1856)	76.00	2.00		*5.25		0.75	16.00			Lead	Fritted body; the soft porcelain made at Limoges on much the same recipe, has sometimes a borax glaze.
37. Tournay	76.45	7.35	Trace.	0.39	6.00		11.20			Boracic	A very good ware, stronger than the Sèvres, and suited to household use; also good for decoration.
38. Persia	90.00	1.50	0.80			1.50	3.00	*6.60			This is the analysis of an opaque, fritted paste, which, when sufficiently baked, produces a real translucent porcelain, having generally a silica-alkali glaze. In porcelain paste, as in all others, the proportions vary slightly at different times, but never to any great extent.

---

* Alkalies.

* Water.

RIVER MINING.

By R. L. Dunn, E.M.

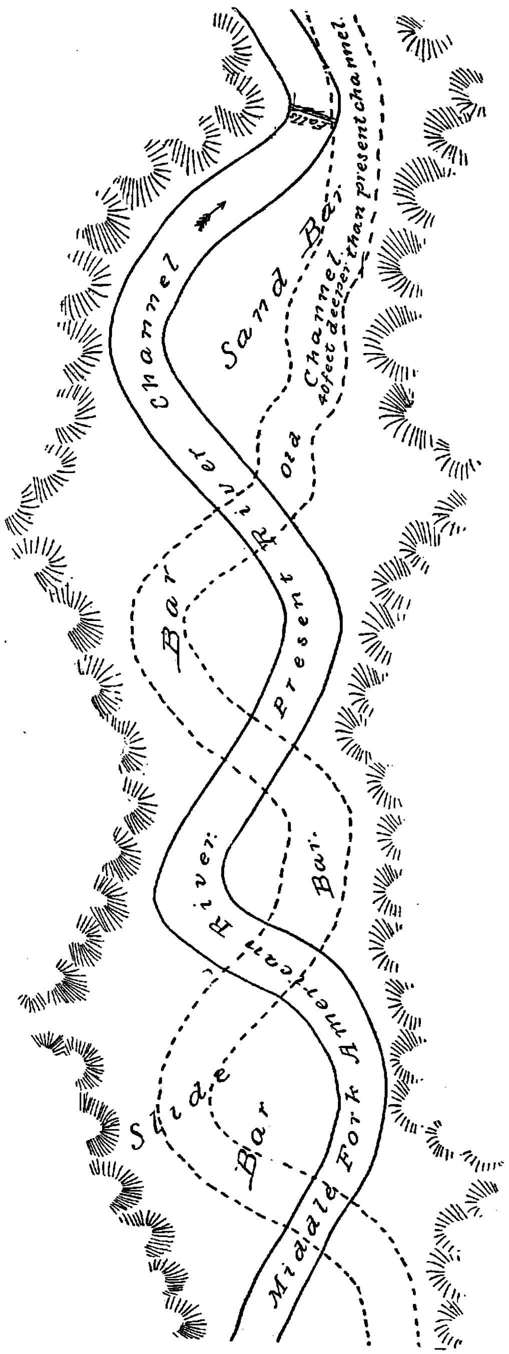
River mining is a branch of placer mining that is carried on in the channels and beds of rivers and large streams. Practically it may be considered as including the mining of such deep bars as have to be exploited below the surface of the water in the adjacent river. River mining is not local to California, though undoubtedly carried on to a greater extent here than in any other gold-bearing district in the world. As contrasted with gulch and ravine mining and hydraulic mining, it is dry season work, only practicable when the rivers are in their low water stages. Probably no other branch of our gold mining industry is subject to more uncertainty under ordinary conditions than is river mining, yet in no other branch are as large returns possible with comparatively small capital. In the early mining history of California, after the rapid working out of the shallow placers of the high bars, attention was turned to the river channels as the next most certain source for a large gold yield, and in 1852, 1853, and 1854, a very large amount of this mining was done, and most of the gold yield of the State at that time came from this source. During these years all of the large gold-bearing rivers in the State were worked, but the industry gradually declined in relative importance with the discovery and opening of the mines in the old river channels. Hydraulic mining from 1857–58 practically extinguished river mining in many of the rivers by reason of tailings covering up the river claims, and it is only since 1880, coincident with the restriction of hydraulic mining, that the attention of mining men has been directed to the river channels.

The rivers which have been and are now the locality of this branch of mining, are the Klamath, Salmon, and Scott Rivers, Trinity River, and the main Sacramento above Redding, Feather River above Oroville and its four large forks, Yuba River above Smartsville and its main forks, Bear River, the North, Middle, and South Forks of the American River, Cosumnes River, Mokelumne River, Stanislaus River, Tuolumne River, and Merced River. Of these the Cosumnes, Mokelumne, Stanislaus, and Merced Rivers are practically worked out and abandoned, certainly so far as any large operation is concerned. The low water flow of these streams is comparatively small and easily controlled, and the tailings from hydraulicking did not get into the river channels until they had been thoroughly worked. The very little mining in these streams of late years has been by small companies of Chinese handling over tailings and the few unworked spots overlooked by the old miners. The South Fork of the American River, and Trinity River, are practically abandoned, though it is probable that in both streams there yet remain unworked portions of the bed that will pay. The large volume of water in the main Sacramento River above Redding has prevented work in that stream to any extent, and it is not likely that any successful mining on a large scale will be possible there till the low water volume of the stream has been materially reduced by diversion for irrigation. The remaining streams are thus practically the only available ones for this branch of mining. Of these the Yuba and its forks, Bear River, and the North Fork of the American contain large areas of unworked ground known to be rich, but buried beneath large masses of hydraulic tailings. These tailings, however, contain in the aggregate a large amount of gold, and have thus enriched the river beds for future mining. The winter floods, with the cessation of hydraulic mining, are now ground sluicing on a tremendous scale, washing the tailings that have been slacking and disintegrating for years, and concentrating the gold they contain into a smaller bulk of gravel. A few years of this operation and these rivers can again be profitably mined.

The localities of active mining operations in this branch of mining at the present time are confined to the Klamath, Salmon, and Scott Rivers, in Siskiyou County; the Feather River in Butte County, and the Middle Fork of the American River in Placer and El Dorado Counties, with a little work by Chinese high up in the forks of the Yuba River.

Klamath River ever since the discovery of gold in its bed has been continuously mined and is still a long way from being worked out. The conditions for river mining in this stream are very favorable. Though carrying a large volume of water, it has nearly everywhere a considerable grade and velocity of current with no great depth. Hydraulic mining tailings have not accumulated and covered up the claims, and mining in it has been so continuous that the location of the worked and unworked portions of the bed are well known, and there is not the uncertainty on this point that is the case with the other noted streams. At the present time there are about twenty-five claims being worked on the Klamath and Salmon Rivers, employing three hundred men. Operations in this locality are generally on a small scale and involve the use of but little capital. The Feather River, in Butte County, is the location of the two most extensive river mining operations in the State. These will be considered in detail further on. The Middle Fork of the American River, though worked very extensively in the fifties, still contains much valuable ground, particularly in deep bars and in portions of the main channel that the early miners could not drain or bottom. A considerable amount of river mining is now being done at several points on this stream, and new enterprises are under consideration for the immediate future; the successful results of the present work having encouraged the investment of capital.

The rivers in which river mining is carried on run in narrow cañons more or less difficult of access. Usually the hill and mountain slopes rise directly from the water's edge, but the streams meander for portions of their course from side to side of narrow valleys, leaving small flats, or "bars," as they are termed by the miners, alternately on one and the other side of the stream. The formation of these bars is due to the action of the flowing river. During the period of its gradual erosion, slides from the hillsides, or the accumulating debris of floods, have changed the course and channel of the streams, and widened the cañons to narrow valleys. These bars, sometimes high above the present channel of the river, sometimes lower than it, are nothing but portions of its former bed. Often a secondary erosion so changes them that their identity is lost, but wherever they are, the dynamic and hydraulic forces that formed them made them natural riffles and storehouses of placer gold. These deep bars were the dream and the snare of the early miners, probably more effort and capital being expended in unsuccessful attempts to mine them than in any other of the early mining operations, the fabulous yield of the few successfully worked deep bars and adjacent river-bed encouraging similar undertakings, that were only abandoned after successive failure had demonstrated the inadequacy of the appliances and methods employed.


Falls
Present River Channel
Sand Bar
Old Channel 40 feet deeper than present channel.
Bar
Bar
Middle Fork American River
Slide Bar

The diagram of a river channel used as an illustration is from a rough sketch of a portion of the Middle Fork of the American River, a few miles above Auburn. It is as good an example of "bar" formation as could be shown. The lines dotted as old channel are, of course, only illustrative not actual, as but little of the surface of the bars has ever been removed, and that which has, if anything, indicates that the river at different times used several lines of flow, and made corresponding erosions in the bedrock. Not shown on the diagram, but a few hundred yards further down stream, a tremendous slide at one time blocked the river, and probably caused the formation of the bar marked "sandbar," and contributed more or less to the formation of the other bars. This slide, or another adjacent to it, left a natural dam and falls in the river, which have only recently been blasted out to make possible the mining of the river-bed and bars shown in the diagram. The present channel of the river is at points a short distance above the falls, thirty to fifty feet higher than the old channels as exposed by mining.

River mining is almost entirely a problem of restraining and handling large volumes of water. In the rivers it involves dams and pumps to control the water, so that the bed of the river can be exposed and mined. In deep bar mining the river waters also require control and must be drained away and their influx prevented, and it is this similarity of condition that makes it desirable to consider both under the general term "river mining," though the appliances employed for the latter are of a more permanent character and involve the outlay of more capital than is required for the former.

The season during which river mining is possible begins with the receding of the flood waters in spring, and continues until the first rains in the fall raise the waters again. Sometimes this first rise does not destroy the mining plant in the river-bed, and a period of low water following lengthens the season till the winter storms come. The season is therefore an uncertain quantity, varying from year to year, and different in different streams. On the Klamath River and its tributaries the season is given as eight months, beginning about the middle of March or the first of April, and ending about the first of December. On the Middle Fork of the American it begins about the first of May and continues till the first of November, usually, though sometimes shut down as early as October, and sometimes not till the end of December. In the Feather River the season is even shorter, it not ordinarily being practicable, on account of the large water flow, to begin operations before the middle of May, nor to continue them after the first of November. The time that can be given to actual mining and taking out of gold is, however, only a comparatively short part of this season. From the nature of the appliances required and their location in the river-bed they have to be put in anew for every season's work, and frequently the work of fitting up leaves only a few days for mining before the rising waters sweep away in a few hours the work of months. Ten, twenty, or thirty days is not uncommon as the time employed in actual mining, but yields of from $500 to $5,000 a day for this time are often realized, repaying well the labor and expenditure of fitting up.

River mining, considered with reference to appliances for working, can be considered under subdivisions, as follows:

1. River mining by temporary wingdams, an upper and a lower crossdam, and a connecting dam in and aligning with the stream, reclaiming a portion of the river-bed for mining, and forcing the waterflow to the opposite side of the channel without raising the level of its flow materially.

2. "Fluming," or river mining with two temporary cross dams and a temporary flume laid as near the low water level of the stream as practicable, into which the entire flow is diverted by the upper dam and conducted over the lower. By this method the water level behind the upper dam is only raised from three to four feet.
3. River mining with an upper dam raising the water level above the ordinary high water line, diverting the entire flow into a flume or tunnel of permanent character. The upper dam may or may not be designed to be permanent.
4. River mining through permanent shafts, hoisting and pumping plant on the banks of the stream, and mining by drifting under the channel.
5. River mining by elevators, dredges, vacuum pumps, and all similar plants, placed usually on a barge or float, and working underneath the surface of the water.
6. Deep bar mining by shafts and drifts.
7. Deep bar mining by stripping and "pitting," employing either steam or hydraulic lifts or elevators.

WINGDAMS.

River mining by wingdams is the usual method where the volume of water is too great to be flumed. At the present time it is the method exclusively employed on the Klamath River. Considerable of the old mining on the Feather, Yuba, and American Rivers was done by the construction of such dams, but they are seldom seen there now, except where small companies of Chinese are at work.

The wingdams made for mining are temporary structures, made usually at a cost only of the labor employed. For the "head" (upstream) dam the upper end of a riffle is selected if possible, and two parallel walls of bowlders are built, not less than six feet apart, and the space between filled in with gravel and sand, the former nearest the outer wall, as sand would gradually wash through the spaces of the bowlder wall and the dam would not be tight. When these walls reach about the middle of the stream, or as far out as it is desirable to mine, they are turned down stream and continued to the lower limit of the ground to be inclosed, then turned, on a riffle if possible, and the "tail" (down stream) dam built, connecting with the same side of the river from which the head dam sets out. Considerable care is required in filling between the walls, in order to make a tight dam. The mining ground thus being walled in, its drainage is then effected by what is now commonly known among miners as a Chinese pump, located at the lower end of the mining ground or in its deepest hole. The motive power for this pump is the current of the stream. An undershot waterwheel is built and placed in the stream alongside of the dam, so that the current impinges directly against the paddles. The pillow blocks on which the shaft rests are made of piles driven in the bottom of the river and buttressed by as large bowlders as can be placed against them. The pillow blocks are not fast, but work in vertical slides and can be raised or lowered by levers, so as to control the running of the wheel. If necessary another wingdam is built out from the other side of the river, to turn the force of the current still more against the wheel. This wheel being very liable to be swept away and lost when high water comes, is constructed as simply and cheaply as possible. For the shaft a twelve-inch square timber is used, the ends rounded and protected with iron rings, into which the gudgeons of the two or two and one half inch cast journals are driven. The diameter of the wheel is usually ten or twelve feet, and the width, dependent on the work it has to do, from eight to eighteen feet. The arms are made of two by four scantling, sometimes morticed into the shaft, but preferably spiked to flanges made of doubled inch boards from sixteen to twenty inches deep. Three or four sets of twelve arms each are placed on the shaft, this depending on the width of the wheel, and paddles made of inch lumber and twelve inches wide dip into the current. The journals turn in seasoned oak boxes resting on the pillow blocks. A wheel so constructed can be broken to pieces quite rapidly and the shaft, the valuable part, saved for another season's work when it would not be possible to save the wheel entire. Between the wheel and the pier on the side toward the dam, is the gear connecting with the counter shaft, usually a rubber or leather belt running on a wooden drum three feet in diameter and with a twelve to twenty-four-inch face, which runs the pump. The pump is simply an inclined box made of one or one and one half inch lumber and from sixteen to thirty-six feet long; attached in it at the bottom and under the water is another drum not as large as that on the counter shaft; over these two drums and through the pump box or barrel runs a tight rubber or canvas belt, from twelve to twenty-four inches wide, dependent somewhat on the quantity of water that must be handled, and specially prepared, if the latter material is used, to resist rotting and the grit of the water; on the outer side of this belt, three feet apart, are fastened paddles three to six inches wide, and of length equal to the width of the belt. The belt and these paddles just fill the pump box, the lower end of which being open under the water surface and the upper end opening into the discharge flume or box, a continuous stream of water of large volume is pumped or elevated. For lifts of from twelve to twenty feet this style of pump is very effective, and water is frequently elevated thirty feet by means of them. Some of the larger of these pumps handle fifty inches of water. With one or more of them to clear and to keep clear the area inside of the wingdams, the ground is ready for mining. The only appliance required for this, other than picks, shovels, wheelbarrows, and sluice-boxes, is a derrick. This consists of a stout mast sixty to one hundred feet high with a boom guyed with six wire ropes. It has the usual blocks, tackle, and windlass, and its utility is in handling large bowlders, clearing away waste for the pit, and in lifting gravel to the sluices, though this last is more often done with one or more lifts of shoveling or by wheelbarrows. Where much work is done with the derrick it may be operated by a small current wheel similar to that already described. For the washing of the pay gravel a small stream of water is let in through the head dam. Should it not be possible to get sufficient grade for the sluices and their discharge over the tail dam, what is termed a dip wheel is used to raise the necessary water; this is a wheel run by the current, but of larger diameter, twenty to twenty-six feet, and less width, four to eight feet, than the wheel used for pumping; on one or both ends on the periphery are buckets that, with the revolution of the wheel, dip up water and discharge it into the washing sluices.

The gravel containing gold is almost invariably right on the bedrock and in its crevices. The depth of the pay varies, sometimes being fifteen or twenty feet and sometimes only a few inches. Overlying the pay is a mass of bowlders and gravel, containing little or no gold, which is removed by the derrick or barrows till a pit is excavated down to the pay gravel. This is then taken out down to the bedrock and washed, the bedrock being carefully creviced and cleaned. The area of the cleaned bedrock is then utilized to pile bowlders and as a dump for the stripping of fresh ground. The general experience of river miners has been that the riffles contained the pay gravel, while the deep holes were comparatively barren of gold. Crevices in the bedrock are often wonderfully rich.

The shortness of the season available for work compels the use of the nights as well as the days, large pitch-pine fires or oil lanterns being used for illumination. When the ground inside of the dams is worked out, or the rising water stops work for the season, the claim is dismantled and as much as possible of the plant saved. The derrick is first secured, then the pumps, belts, wheels, and sluice boxes.

The cost of fitting up a claim with wingdams, wheels, pumps, derricks, and sluices, and the excavation of the pit to pay gravel, is sometimes as low as $500, occasionally as much as $5,000, and a safe average of experience places it anywhere from $2,500 to $5,000

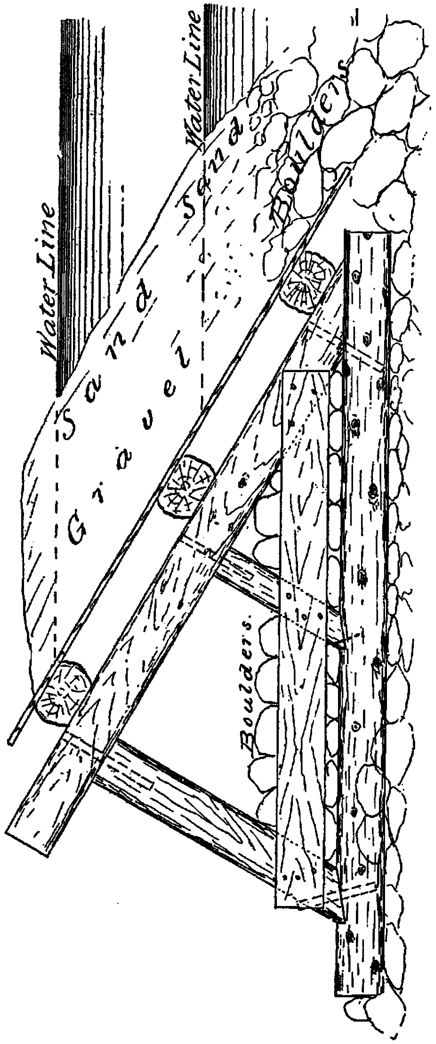
FLUMING.

Fluming, or river mining with head and tail dams across the entire width of channel of the stream, and the diversion of the latter into a flume, is a more expensive and uncertain operation than mining by wingdams, yet much better suited to extensive operations than the other. Where it is possible to mine portions of the bed of almost any stream by means of wingdams, fluming can only successfully be done in the smaller rivers. In the fifties, when river mining was at the extreme height of its importance and prosperity, combinations of several companies of miners working adjacent claims, frequently flumed the smaller rivers for miles and worked every foot of the channel.

The season for flume mining is shorter than that for wingdam work. This is occasioned by the necessity of constructing the flume first, and as the flume cannot be built under water, it is necessary to wait till the river is close to its low water stage before beginning construction. The water in the Feather and American Rivers is usually low enough to begin the construction of a fluming plant between the first and fifteenth of June, though some years it is possible to commence as early as the first of May.

The flume is built on one or the other side of the river as is most convenient, right in the water, in order to have it as low as possible. The dimensions are dependent on the volume of water it is expected to carry. On the North and Middle Forks of the American River, above the junction, from eight to twelve feet was the usual width; below the junction in the North Fork eighteen and twenty feet, width was found necessary. In the Feather River at different points twenty-four to thirty-two feet is required, and in Bear River four to six feet was found ample. The depth of the boxes varies from three to five feet. The grade given should not be less than three inches to one hundred feet; a rapid flow being desirable to give the necessary power for current wheels, and to lighten the weight on the flumes by keeping the depth of flow low. The whole construction is of the most temporary character. Stringers ten by twelve or six by ten, rough pine logs smoothed by the ax, are laid about four or four and one half feet apart, and posted up where necessary; on the stringers are laid the sills or cross-ties, four by four scantling, three feet apart; the uprights, of scantling, are cut round at the foot, and driven into two-inch auger holes in the ties; the wider flumes are braced from the ends of the cross-ties, and the narrower by strips nailed on the tops of the uprights. The bottom and sides are made of inch boards. Experience has found such a flume able to carry water five feet deep without showing any evidences of weakness or giving way. The head and tail of the flume require the most care and attention as regards construction, owing to the danger of leaking or of undercuttings.

At the head the flume is flared out with a gradual taper to nearly double the regular width and projects beyond the line of the head dam from nine to twelve feet, the third or fourth cross-tie being brought into exact line with the stringers or plate on the inclined frames of the dam; before the flume is floored boards are driven down from this tie to the bottom of the stream on the slope of the planking of the dam, so that the jointing with it will be tight. Large rocks, gravel, and finally sand are immediately thrown in on the foot of these inclined planks, to keep the current from undercutting, and the entire space in front of them to the head of the flume is then filled up solid with rocks and gravel before the floor is laid. At the tail end of the flume, in the line of the tail dam, before the floor is laid, two lines of planks are driven down vertically from two of the cross-



Cross Section Timber Dam. Scale ¼ in. to 1 foot.

ties, six feet apart, and the space between filled up with bowlders and gravel, and made a part of the dam.

As soon as the flume is built the construction of the head dam is made. This is a timber dam, but being temporary, and only calculated to sustain the pressure of from two to four feet of water, it is constructed of the cheapest and most accessible materials, as far as possible. The pines on the adjacent cañon slopes furnish the timbers. These are roughly squared and faced with the ax. For the location of the dam the upper end of a riffle is preferable. Frames or bents are first made of timbers eight to twelve inches square. These bents are triangular, and consist of a mudsill ten to eighteen feet long, to which, at one end, the inclined sill or stringer plate is trenailed with a two-inch trenail, the angle between the two timbers being made from 30 to 45 degrees, the frame being then completed by a brace timber set at right angles with the inclined sill and footed into the mudsill, and fastened to both by two-inch trenails. For large frames a second brace is put in. Boards are spiked each side of this frame above the mudsill, making a box, which is filled with bowlders, and enables the frame to be floated upright into place. The placing of the frames, which are set from eight to sixteen feet apart, dependent on the depth of water and force of the current they are set in, is commenced at the head of the flume, care being taken to secure a perfect alignment, in order that the bearing of the stringers and planking shall be evenly distributed. If the current is not too strong, the frame can be put in place by two or three men on each side of a frame; otherwise two ropes are fastened to the nose of the frame and the frame snubbed into place from the river banks. The bed of the river on which the mudsill is seated is smoothed off with a crowbar, the frame weighted into place with bowlders, and temporarily tied to the other frames with strips until all the frames are in place. On the inclined slope of the frames stringers are laid. These are timbers as long as they can be cut, and from eight to twelve inches through between the ax-smoothed sides. These are laid on the inclined sills above the water's surface and forced below it as near to the bottom as possible, the pressure of the current keeping them in place without further fastening. A second stringer is then laid on the frames about four or four and a half feet above the first, which will bring it at the surface of the water usually, and then a third an equal distance above the second. The dam is then planked with inch boards twelve to sixteen feet long, according to the depth of the stream, the planking commencing at the flume and going toward the opposite side of the stream. An expert can push a plank down, edge to the current, until bottom is reached, when it is turned and forced into place with the current, or the boards can be slid down the stringers to the bottom, no fastening being required to keep them in place. As the laying of the planking progresses, large bowlders and gravel are dumped at its foot from a temporary staging, to prevent the current undercutting, and as soon as the planking is completed, bowlders, gravel, sand, and earth are wheeled in and dumped against the planking until the dam is tight and all the water flows through the flume. The tail or foot dam is then constructed, on the lower end of a riffle preferably. Two walls are built of bowlders and large rocks, not less than six feet apart, and filled in between with sand and gravel, the construction being similar to that of wingdams as already described. A tail dam is not always essential, as a riffle may protect the pit against back water. With the completion of the tail dam the pit is ready to be cleared of water. One or more undershot waterwheels are set up in the flume and driven by the current. These furnish power for the Chinese pumps, derrick, and, if used, the electric light plant for working the claim at night. The opening of the ground by pits and the mining out and washing of the gravel has been already described in connection with the method of river mining with wingdams. The ground is mined out underneath the flume and head dam by putting in posts as fast as the support of the ground is cut away. A slight rise of the stream does not necessarily close down mining by wingdams, as the portion of the channel occupied by the water-flow is so large that it may carry the additional water of the rise without overtopping the dams; but in fluming a slight rise may overtax the capacity of the flume and fill the pit. In fluming, the material put into the dam is almost certainly an entire loss at the end of each season; also, it is not expected that any of the flume will be saved. With good luck, the wheels, pumps, derricks, and lighter plant may be taken out of the river and saved over from one season until the next.

The cost of fitting up a fluming claim from year to year cannot be given with even approximate accuracy, as unforeseen contingencies enter largely into it with every different claim, and in different years with the same claim. It is safe to say, however, that this expense, except in very small operations, will not be less than $3,000, and may be $10,000.

PERMANENT FLUMES AND TUNNELS.

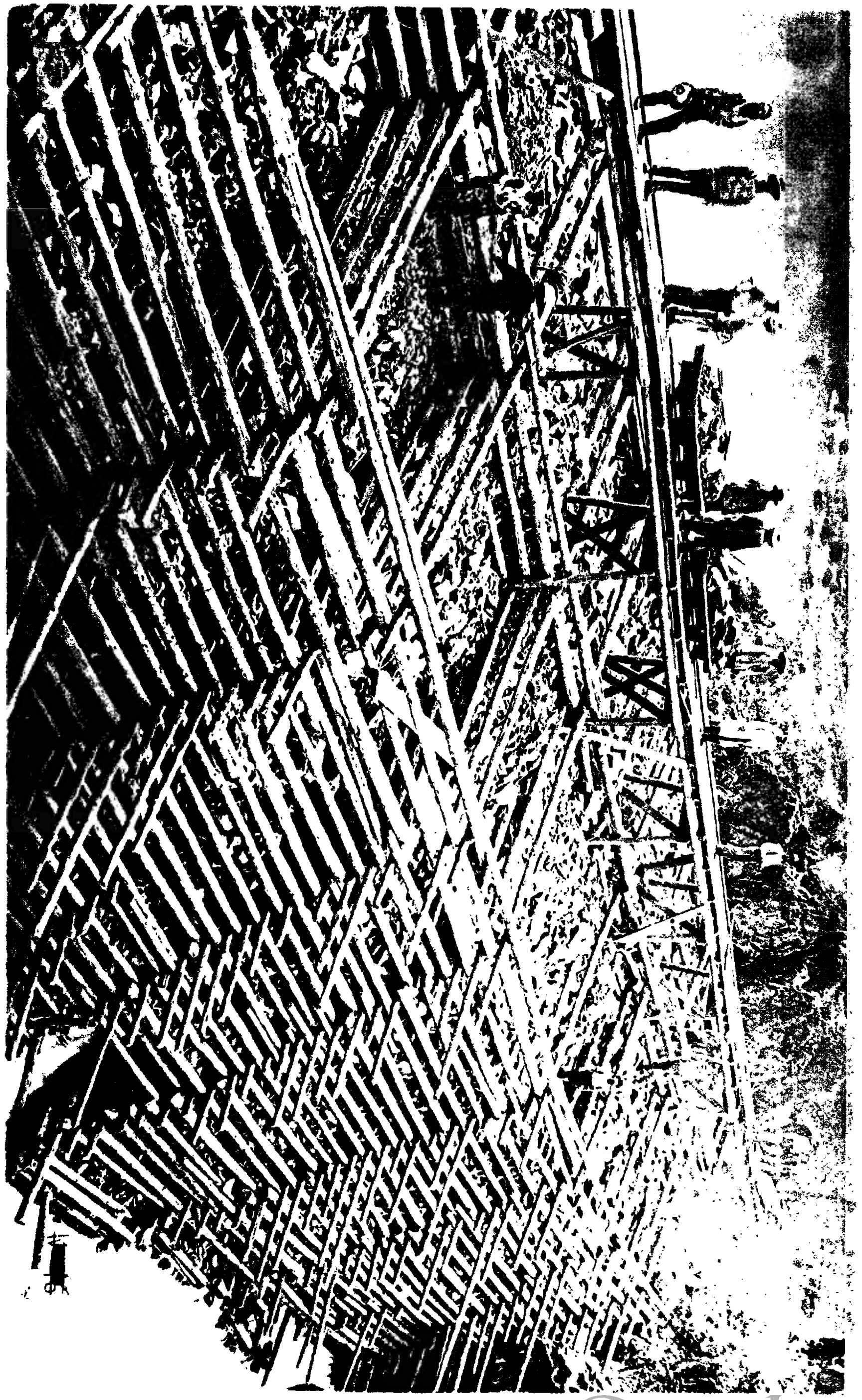
River mining, in which the water is first raised above the high water line by the head dam and then diverted through a permanent flume or tunnel, necessarily requires a considerable outlay of capital, and is only expedient when it is thus possible to drain and open for mining a large extent of river-bed that will require several seasons to thoroughly exploit, even under the most favorable conditions. If a permanent head dam be put in, the season available for work is much lengthened, for as soon as the flow of water reaches the low water stage the river clears itself by diversion into the permanent flume or tunnel. Pits can thus be sunk and mining commenced at a time when, under the usual methods of fluming, the first work of building the flume would only be beginning. Three operations of this class are under way in this State. The Golden Gate Alluvial Syndicate (limited), on the main Feather River, three miles above Oroville, the plant there being a permanent flume with a temporary head dam. The Big Bend Tunnel, on the North Fork of the Feather River, sixteen miles above Oroville. The plant there is a permanent head dam and permanent tunnel draining thirteen miles of river-bed for mining. The Horseshoe Bar Claim, on the Middle Fork of the American River, just below the town of Michigan Bluff. At this claim is a tunnel, the diversion of the stream being directly into it through a shaft. Over a mile of river-bed is thus drained. All three of these merit some detailed consideration.

GOLDEN GATE ALLUVIAL SYNDICATE (LIMITED).

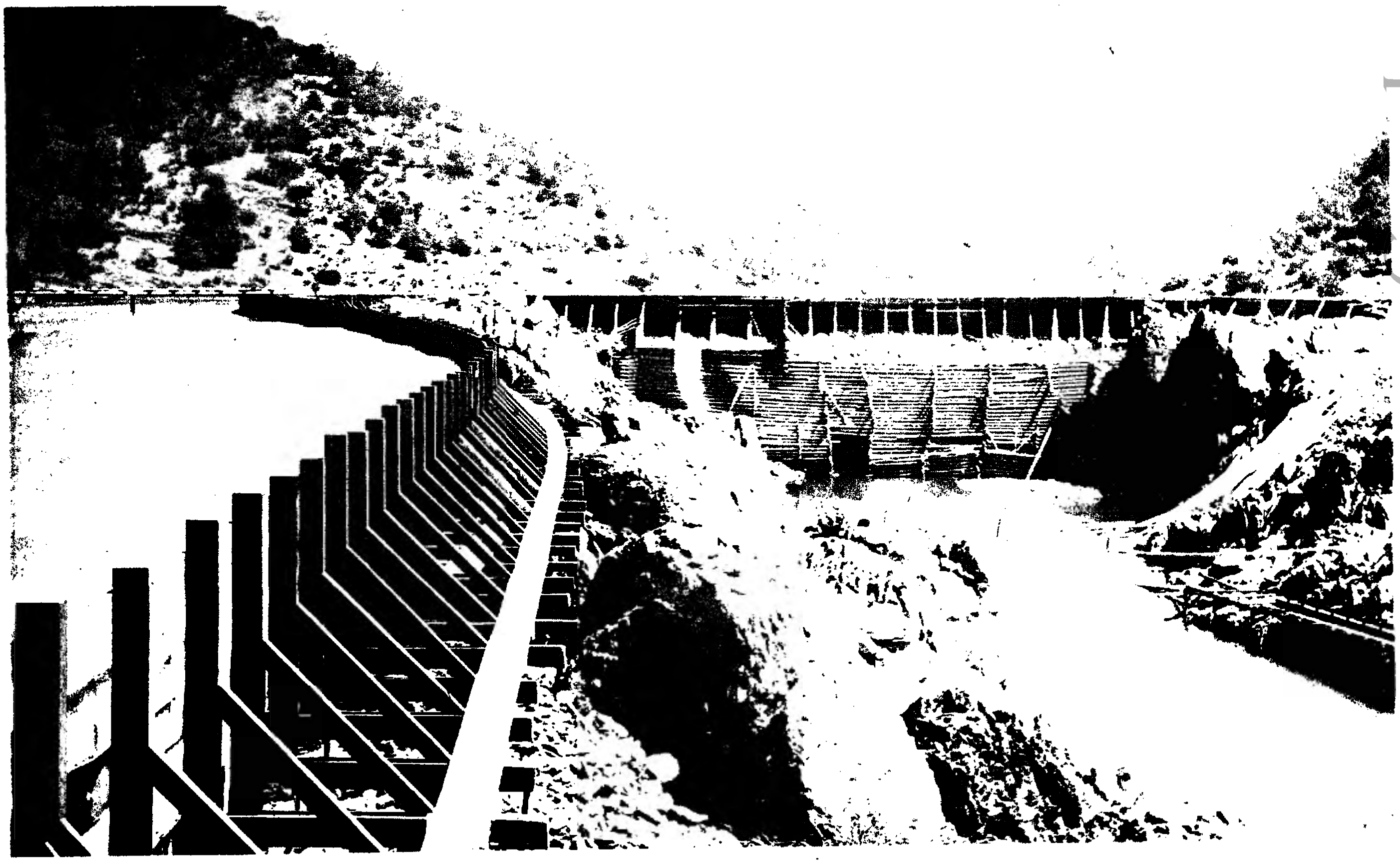
This mine, commonly spoken of as the Golden Gate River Mine, is, as already noted, on the main Feather River. An attempt was made to work this mine in the season of 1889, which was unsuccessful, by reason of contingencies that were not and could not be foreseen and provided against. The ground that the attempt was made to mine comprised three thousand two hundred feet of river-bed, having an average width of channel to be mined of one hundred and fifty feet. The head dam put in for the season, instead of being a light structure, such as has been described, raising the water level at the most but three or four feet, was a comparatively solid structure, raising the water level fifty feet and diverting it into a flume above the high water line. The plant and its construction were as follows:

The sites for the head and tail dams having first been selected, the grade for the main flume was constructed in the winter. Early in May the construction of the flume was commenced. This at the head was made fifty feet wide, tapering in eight hundred feet to the regular width of thirty-two feet. The sides were built five feet high, and it was given a grade of one inch to sixteen feet. In construction, three stringers, eight by eight, spruce timber, were laid, and on these cross-ties six by six and four feet apart. Where there was not sufficient rock bearing, the cross-ties as well as the stringers were posted up. For uprights four by six timbers were used, braced by four by four scantling from the ends of the cross-ties. The bottom and sides were planked with one and one-quarter-inch boards. The tail end of the flume discharged on a bowlder bank, the cutting effect of a high drop being avoided by increasing the grade of the last boxes. The depth of water flow in this flume at extreme low water was two and one half feet, and its velocity eighteen feet a second, indicating a flow of one thousand four hundred and forty cubic feet a second, or seventy-two thousand inches under a four-inch head. This construction employed twenty-five to thirty men and was finished in the middle of June, and the construction of the head dam immediately begun. This had been delayed six weeks by the May storms. The dam was made of cribs ten to fifteen feet square, the dimensions being on the bottom ninety feet across the stream and sixty feet wide, and two hundred and fifty feet long by twenty feet wide on top, the height of the main dam being forty feet, and of the frames on top of this ten feet. The cribs were made of peeled pine poles ten or twelve inches through at the butt and twenty to forty feet long. They were cut above the dam and floated down. The framing was spiked together with wrought iron spikes. The water slope of the cribs, one horizontal to four vertical, was planked with two-inch boards. The dam was only kept tight enough to raise the floating poles within convenient reach for construction as they were needed, the water being allowed to run through the structure till it was completed. The cribs were filled in with rock and gravel brought from both banks of the river by a temporary handcar track. On these cribs was built the upper ten feet of the dam of eight by eight timber frames, such as have already been described, and through it was a waste gate ten by forty feet. This gate was intended to let that portion of the first fall rise in the river, usually coming in October, through the claim, should the flume fail to carry it. The first October rise of 1889, however, proved too large for it, and a portion of the head of the flume was swept away. The dam when completed was made tight by dumping in gravel, sand, and earth on the boarded water slope. The construction of this dam required seventy thousand linear feet of pine poles, and twenty thousand tons of rock and gravel, and it was finished August thirteenth.

The tail or foot dam was made of a single line of nine by nine feet cribs, and filled in with rock and gravel. Its height was from four to six feet. This dam and the construction of a subflume in the bed of the river were made at the same time. The object of the subflume was to carry off the seepage through the dam and that pumped from the pit. It was built four feet wide and three feet deep on a grade of one fourth of an inch to sixteen feet. The pumping plant consisted of two elevators, two Chinese pumps with boxes three by twenty-eight inches, and a centrifugal pump. The lift for the pumped water was twenty-eight feet. The elevators had columns or barrels eleven inches in diameter, with a ten-inch throat, this latter proving too large for good work. They were operated with two hundred



GOLDEN GATE MINE, FEATHER RIVER, BUTTE COUNTY. DAM UNDER CONSTRUCTION.



GOLDEN GATE MINE, FEATHER RIVER, BUTTE COUNTY. DAM COMPLETED. HEAD OF FLUME.

and seventy-five feet head of water from the Palermo Ditch. One of them, with a two and one half-inch nozzle, used one hundred and seventy-five inches of water; and the other, with a three-inch nozzle, took two hundred and eight inches. The mine was ready for pumping on September first, but no water could be had for the elevators till in October, after the first rains. Meanwhile the other pumping plant had been put in, and was run by three overshot waterwheels—one eighteen feet in diameter and four feet wide; the other two (found too small) were twelve feet in diameter, with the same length of bucket. The construction of this plant, and further delay caused by the damage to the head of the flume from the first rise of the water, made it the eighteenth of October before the pit was pumped out and the ground prepared for mining. On this date the second October rise came so suddenly and unexpectedly that the head dam was overtopped and the plant in the bed of the river swept away before any mining had been done, and before any of the plant could be saved. Nothing was learned regarding the depth or richness of the pay gravel. The dam stood till the water flowed over it four feet deep, when it gave way, and has been washed out completely. It will be noted that the season for mining, or rather for putting in the plant, was unusually short, being only from the middle of June till the middle of October (four months), where usually it would be from the first of May till the first of December, or seven months. The total contract cost of plant and fitting up has been given to me as $100,000.

That this portion of the main Feather River is rich is well known. Though it has been worked considerably by wingdams, there is only one instance of successful fluming. In 1857 the Cape River Claim (the present Golden Gate ground) was flumed for three thousand two hundred feet, at an expense of $120,000. Only forty days were available for work before high water came and shut down the mine, yet in that short time $680,000 was taken out, single day's products reaching as high as $21,000.

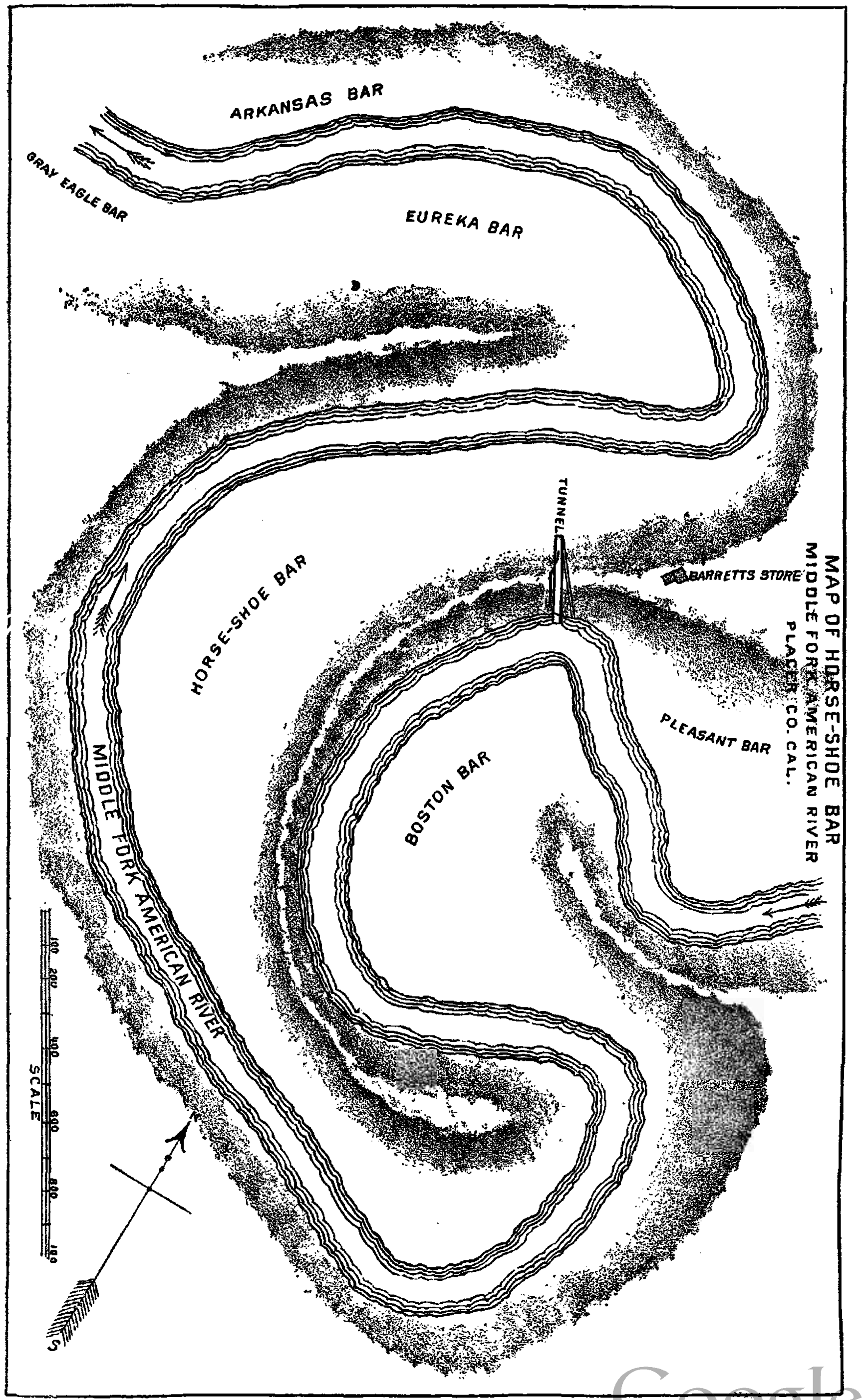
BIG BEND TUNNEL.

This is unquestionably the most important river mining enterprise ever undertaken, both as regards the amount of capital employed and the area of river-bed developed for mining. The North Fork of the Feather River is the largest individual stream in the gold mining district of California. Both above and below Big Bend it had been mined by wingdams and fluming, and the rich returns obtained demonstrated its great richness. That portion of the channel in Big Bend was reputed not to have been so extensively mined, but the small portions of the bed and bars that had been wingdammed and flumed were known to have yielded equally as rich returns as the more accessible portions of the river-bed referred to. The topographical character of this portion of the channel is more than ordinarily rough, and the cañon all but inaccessible. The channel of the river forms roughly three sides of a four-mile square, and the fourth, or land side, is penetrated by a ravine known as Dark Cañon from the west branch of the Feather River, which joins the North Fork below the Bend. From this ravine a tunnel line, twelve thousand feet long, was projected on a grade of thirty feet to the mile, coming into the North Fork at the upper end of the Bend. The construction of this tunnel (the preliminary work of building roads, buildings, and engine plant having been first completed) was begun in November, 1882, and finished in April, 1886. The plant comprised a No. 4 Burleigh air compressor, arranged to be driven either by steam or water power, with a four by sixteen air tank; subsequently a No. 4 Clayton duplex compressor was put in; four Burleigh tunnel drills mounted on a Buffalo drill carriage; for steam power, a four by sixteen boiler; for water power, an eight-foot Knight wheel, using one hundred inches of water from Dark Cañon under two hundred and seventy-five feet head; a No. 3 Knowles pump; a two by eight Llewellyn heater; a No. 5 Baker blower and engine; and tunnel cars and mules for hauling them. The tunnel was first constructed nine by sixteen feet (the original estimates, however, were for twenty-five and one half feet width and twenty-one and one quarter feet height), but on completion, being found too small to carry the water flow, the height was increased to sixteen feet. The rock penetrated is slate of varying degrees of hardness, with occasional stringers of quartz and granite (probably diorite). In only a few places did it require timbering, a remarkably fortunate circumstance, for had soft rock been encountered it would have proved a very difficult problem to keep the tunnel in condition for water to flow through it. The larger amount of powder used was of the No. 1 Giant grade, the loading of the holes varying, of course, with the hardness of the rock. As a whole, the running of the tunnel was remarkably uniform, being as follows:

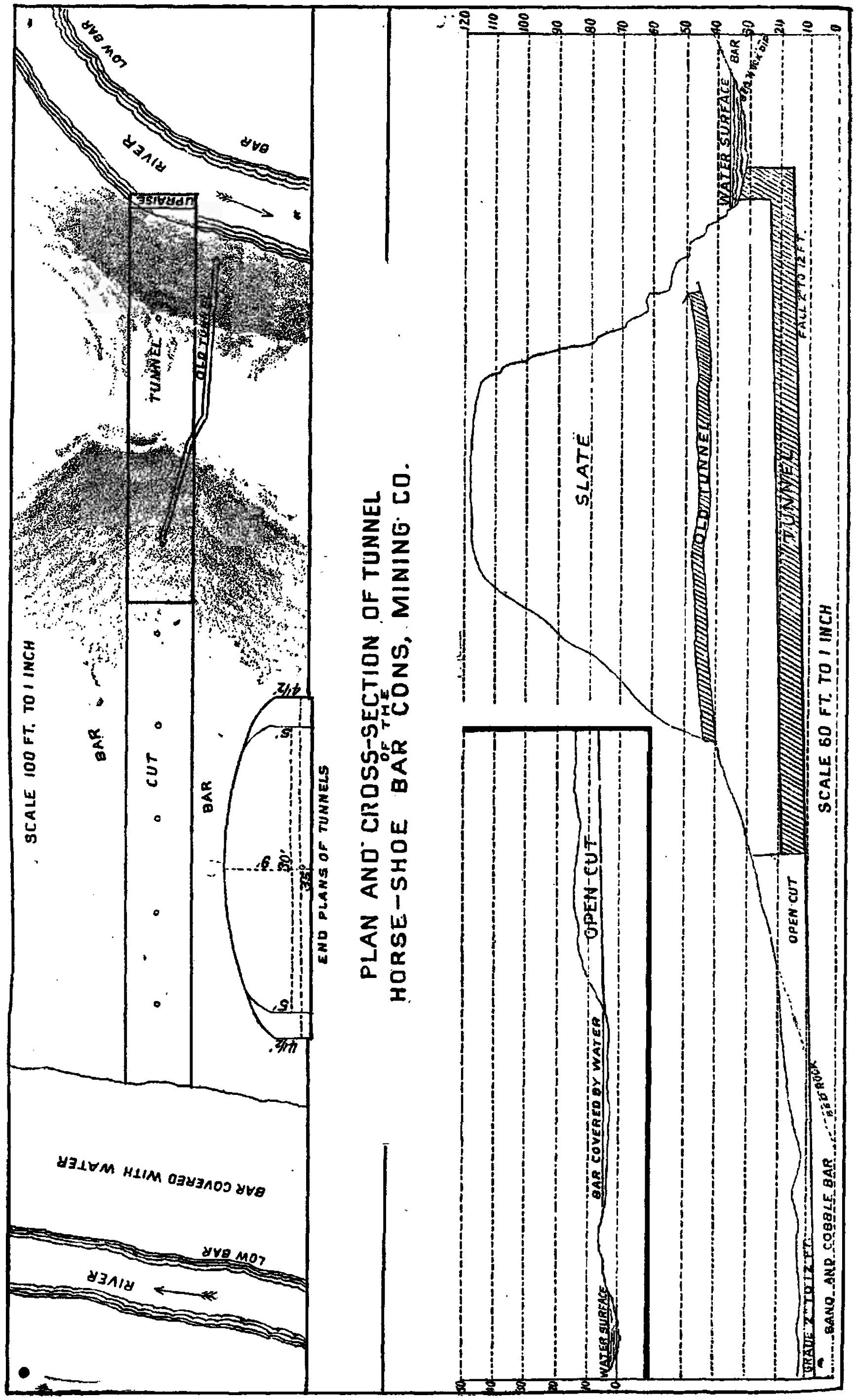
Distance run by hand prior to November 18, 1882	26 feet.
Distance run by drills between November 18 and December 31, 1882	373 feet.
Distance run by drills between January 1 and December 31, 1883	3,503 feet.
Distance run by drills between January 1 and December 31, 1884	3,090 feet.
Distance run by drills between January 1 and December 31, 1885	3,855 feet.
Distance run by drills between January 1 and April 12, 1886	1,155 feet.
Total	12,002 feet.

The head of the tunnel was flared out to thirty-two feet and given an increased grade, the floor being left four feet lower than the bed of the river, to give still more initial velocity to the water flow. The water was first turned into the tunnel by a temporary dam, and a permanent dam, one hundred feet base and sixteen feet high, then put in. The tunnel entrance is closed during high water by heavy castiron gates and all the water allowed to flow through its natural channel.

The seasons of 1886 and 1887 were lost for mining by reason of the necessary enlargement of the tunnel already referred to, but the seasons of 1888 and 1889 were utilized. In 1888 an attempt was made to utilize the water power at the Dark Cañon end of the tunnel for mining in the river-bed, an electrical plant being put in for that purpose. It seems not to have been very satisfactory, the complaint being uncertainty of control, and it was abandoned after that season's trial. Financially, that year's mining was not successful, the pits opened showing that the sides of the river had been wingdammed at those points more than had been supposed, and that the deeper ground in the unworked center of the channel contained but little gold, the bedrock being hard and washed smooth. In the season of 1889, a small force was worked and some gold taken out, but nothing commensurate with the outlay of capital already made. It is claimed that the river-bed is so choked and filled with enormous bowlders beyond the power of derricks to handle, that the little gravel between and under them, though undoubtedly rich, cannot be profitably mined. Of this I have no personal knowledge, but it seems that, though no such enormous returns can possibly be had as were expected from the preliminary examinations, there is no reason for abandoning the enterprise yet.



MAP OF HORSE-SHOE BAR
MIDDLE FORK AMERICAN RIVER
PLACER CO. CAL.



HORSESHOE BAR RIVER MINE.

This is practically a similar operation to the Big Bend just described. The Middle Fork of the American River, just below where Michigan Bluff is situated, is a small stream in extreme low water, flowing about one hundred and fifty cubic feet a second. As will be seen by the map, the meanderings of the river channel around hard reefs of slate give a specially favorable chance to drain the river-bed by a tunnel. This has been twice attempted, but the first tunnel (the upper in the detail plan) was too small to carry the water and higher than it needed to be. The lower tunnel constructed during the last four years is entirely satisfactory. No dams are built, the river flow being allowed to go through the tunnel, which is only two hundred and eleven feet long, all the year. The inlet end of the tunnel is a shaft thirty feet deep in the river-bed. The value of this mining proposition seems to be more in the bars than in the river-bed itself, which had been flumed and worked out. These bars are deeper than the present channel of the river and have never been bottomed except over very small areas, which have proven rich enough to warrant their thorough exploitation.

Nothing more than the construction of the tunnel has as yet been done, the mass of sand and gravel overlying the pay gravel on the bars being so great that pitting by the usual method of hand labor is both too uncertain and too expensive to be advisable. The method of work approved and decided on by the owners of the property is the use of hydraulic elevators run by water under high pressure. This will require either the construction of a ditch several miles long from the river above the mine, or the obtaining of the water from the Georgetown system on the south side of the river. This latter has heretofore been unable to furnish the necessary supply, and thus delayed the working of the mine.

RIVER MINING BY DRIFTING.

This method of mining involves the sinking of a shaft in solid ground out of reach of high water, placing in it a hoisting and pumping plant, and then drifting out from the bottom under the flowing river into the pay gravel, which is then taken out through the shaft. This method is to be condemned, though it has been moderately successful in a few instances where very deep ground had to be bottomed. It is next to impossible to keep the underground workings from being drowned out or from being caved in. A river-bed with its quicksands and loose gravels and bowlders is naturally very unstable and unsafe to work under.

RIVER MINING BY DREDGERS, ETC.

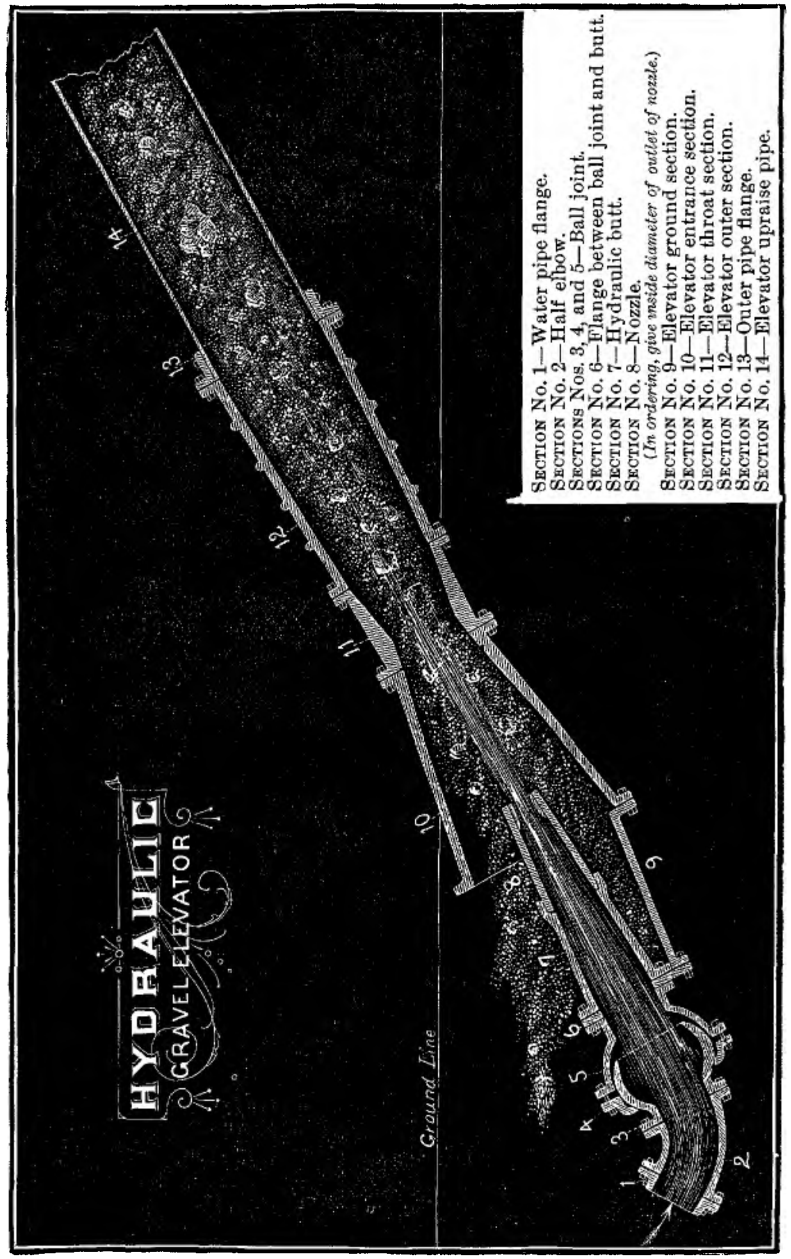
Numerous attempts have been made to mine the river-beds from floating scows or platforms by means of dredgers and various styles of pumps, or combinations of the two. A barrel or cylinder lowered to the bed of the river and from which the air is exhausted, and the auriferous sands and gravels then forced in by the atmospheric pressure, is a favorite device with the purely theoretical river miners. The cylinder filled is then lifted to the boat by a derrick and the contents discharged into sluices and washed. If there is gold in the gravel some is necessarily brought up from the river bottom and obtained. These vacuum lifts, pumps, and dredgers are, however, practically unsuccessful by reason of the conditions under which the gold exists in the river-beds, and these conditions have been so thoroughly developed in all the trials made of this boat mining, as it may be called, that the method can be unqualifiedly condemned without the expense of a practical trial. It must be evident that it is impossible to either clean bedrock or to crevice it by any of these devices, and it is on and in the bedrock that the larger amount of the gold is to be found. Also, it is impossible to work around or under large or even moderately sized bowlders. In a river-bed, where the bowlders are very large and form the bulk of the ground to be handled, these boat machines are useless. Where there is a considerable depth of light gravel it is difficult to excavate a pit, the sides being caved in by the water and the discharged tailings sliding back. With the river muddy, as mining streams usually are, operations are entirely blind. Work is of necessity confined to low water stages, and there is considerable difficulty in saving the plants from damage or destruction by high water.

BAR MINING BY DRIFTING.

This method of bar mining has been very commonly employed for deep ground. It is in every respect drift mining rather than river mining. The opening of the mine is a shaft in solid ground, with the usual equipment of hoisting and pumping plant. Like drifting under a river-bed already described, it is subject usually to the disadvantages of soft ground overhead, and a large amount of water. Considering only the unworked ground on our California rivers, it is a more desirable method for temporary prospecting than for permanent work. The inflow of water increases with the extent of the underground opening of the drifts. In prospecting but little expense is incurred for plant. The shaft is made circular, and only large enough for a man to work in. The hoist is a windlass and bucket, also used to keep the shaft clear of water. If the amount of water proves too large to be handled by the bucket, a common lift pump, such as is used in wells, is employed, but very seldom anything more permanent or costly. It sometimes happens that no water-bearing seam is cut in sinking, making it possible to mine out a considerable area at the foot of the shaft, and to extend the operation beyond mere prospecting of the ground. For deep bar mining, where the bar is deeply covered by a slide, drifting from the foot of either a slope or vertical shaft is the only practical method that can be employed. At the best, it is expensive and uncertain work. The pump plant should be made at the outset ample to handle any probable increase in the water flow as the extent of the drifts is increased by mining.

DEEP BAR MINING BY ELEVATORS.

Where it is possible to obtain large heads of water under considerable pressure, the mining of deep bars (except where covered by slides) and extended areas of river-beds that have been opened by fluming, is most economically and rapidly effected by means of what are called hydraulic elevators or lifts. This style of plant has already been incidentally referred to in connection with the Golden Gate and Horseshoe Bar Mines. These elevators consist of a wrought iron upraise pipe or barrel, of diameter dependent on the vertical lift and water pressure available, those at present in use being from eleven inches to twenty inches in diameter. For convenience they are usually set on a 60-degree inclined framing, though the nearer vertical they are set the better they work. The length of the elevator is of course determined by the slope it is set on and the vertical lift made. The extreme lift now in operation is eighty-nine feet, though I do not consider that the limit of practical efficiency by any means. The lower end is slightly flared out, set in the bottom of the pit open, and with the


HYDRAULIC
GRAVEL ELEVATOR
Ground Line
1
2
3
4
5
6
7
8
9
10
11
12
13
14
Section No. 1—Water pipe flange.
Section No. 2—Half elbow.
Sections Nos. 3, 4, and 5—Ball joint.
Section No. 6—Flange between ball joint and butt.
Section No. 7—Hydraulic butt.
Section No. 8—Nozzle.
(In ordering, give inside diameter of outlet of nozzle.)
Section No. 9—Elevator ground section.
Section No. 10—Elevator entrance section.
Section No. 11—Elevator throat section.
Section No. 12—Elevator outer section.
Section No. 13—Outer pipe flange.
Section No. 14—Elevator upraise pipe.

nozzle of the pipe, carrying water from the pressure box from two hundred to five hundred feet above, projecting into it, and in the line of the elevator. A short distance above the nozzle a throat section is set in, narrowing it from eleven inches to seven and one half to ten, dependent on the amount of wear on the throat section, which, of course, can be replaced when worn too large. The upper end of the elevator is flared out a little, and discharges into a sluice box with riffles for saving gold. The action of this elevator is by the stream of water coming from the nozzle of the pipe and forced through the elevator by the head from the pressure box. This stream going through the throat section with its tremendous velocity creates a very strong suction, which lifts water, sand, gravel, and bowlders from the pit and discharges them into the sluice, where the gold is caught and the tailings discharged on the dump. For the proper action of the elevator, a large amount of water is necessary in the pit all the time. This water is first employed in ground sluicing, piping top gravel and waste off of the pay gravel, and in washing the latter in the pit in small boxes with a sluice head. Large bowlders are handled by the derrick or barrows, and piled in the pit on cleaned bedrock, and the fine material after screening by a grizzly goes into the elevator sump or pit, and is lifted out of the mine. Where the elevator discharges into the sluice the latter is covered by a heavy framing lined with green pine and liveoak logs, on which the water and gravel impinge before dropping into the sluice.

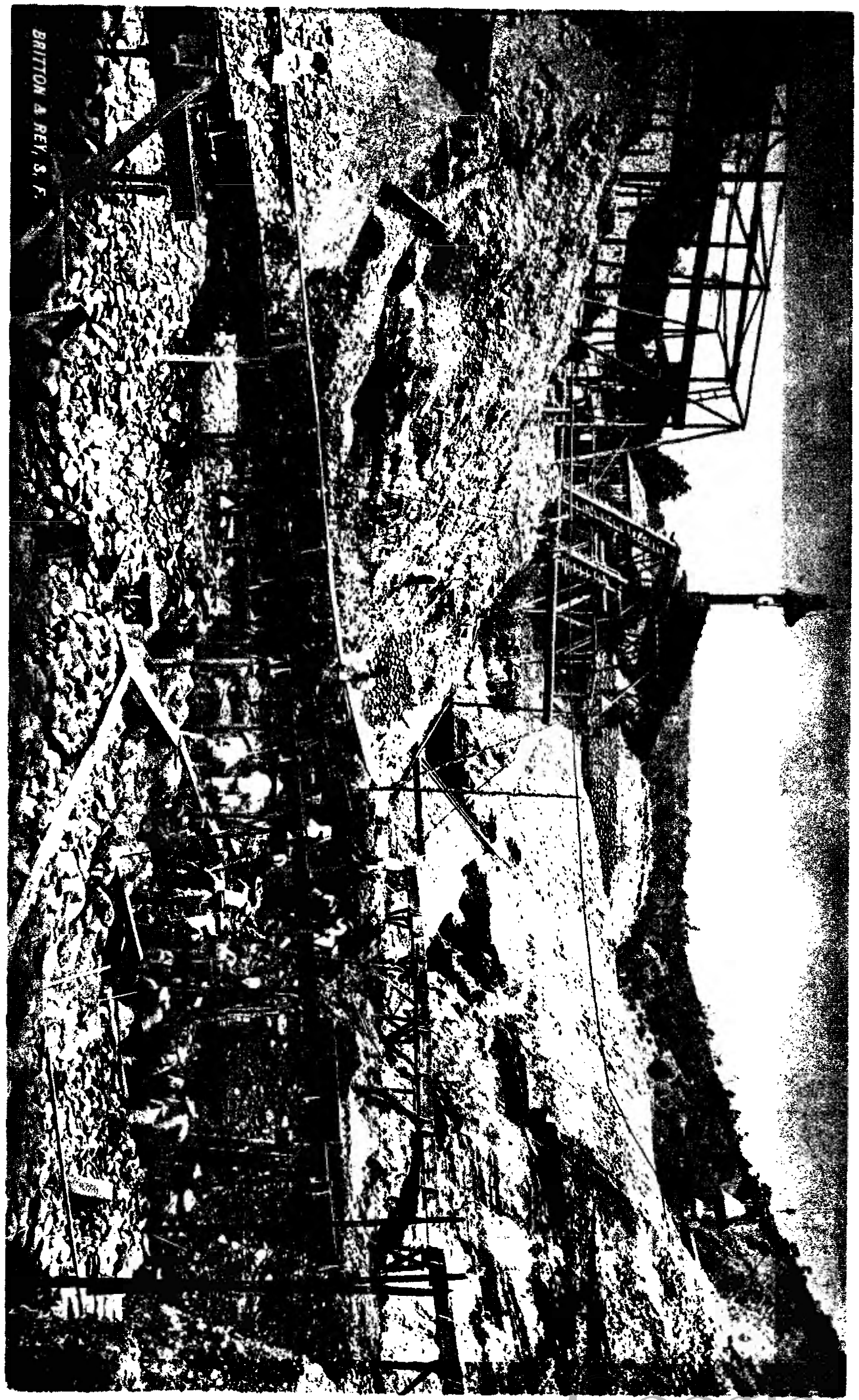
For pumping water, and sand and fine gravel if necessary, another form of elevator is designed and used. In this, the foot of the elevator, placed, if desirable, thirty feet above the sump, is a solid, pear-shaped casting, the nozzle screwing into the bottom and discharging through the throat at the upper end. The suction pipes from the sump enter the sides of this pear-shaped casting.

This class of machine is exceedingly efficient for pit mining. With it the problem of drainage is practically reversed, and the difficulty is not so much to get the water out of the pit as to get sufficient in to mine with. Quicksands and barren top dirt offer no serious obstacles to thorough mining, and the machine does the work of more men than could be practically worked on the same ground, and in a fraction of the time.

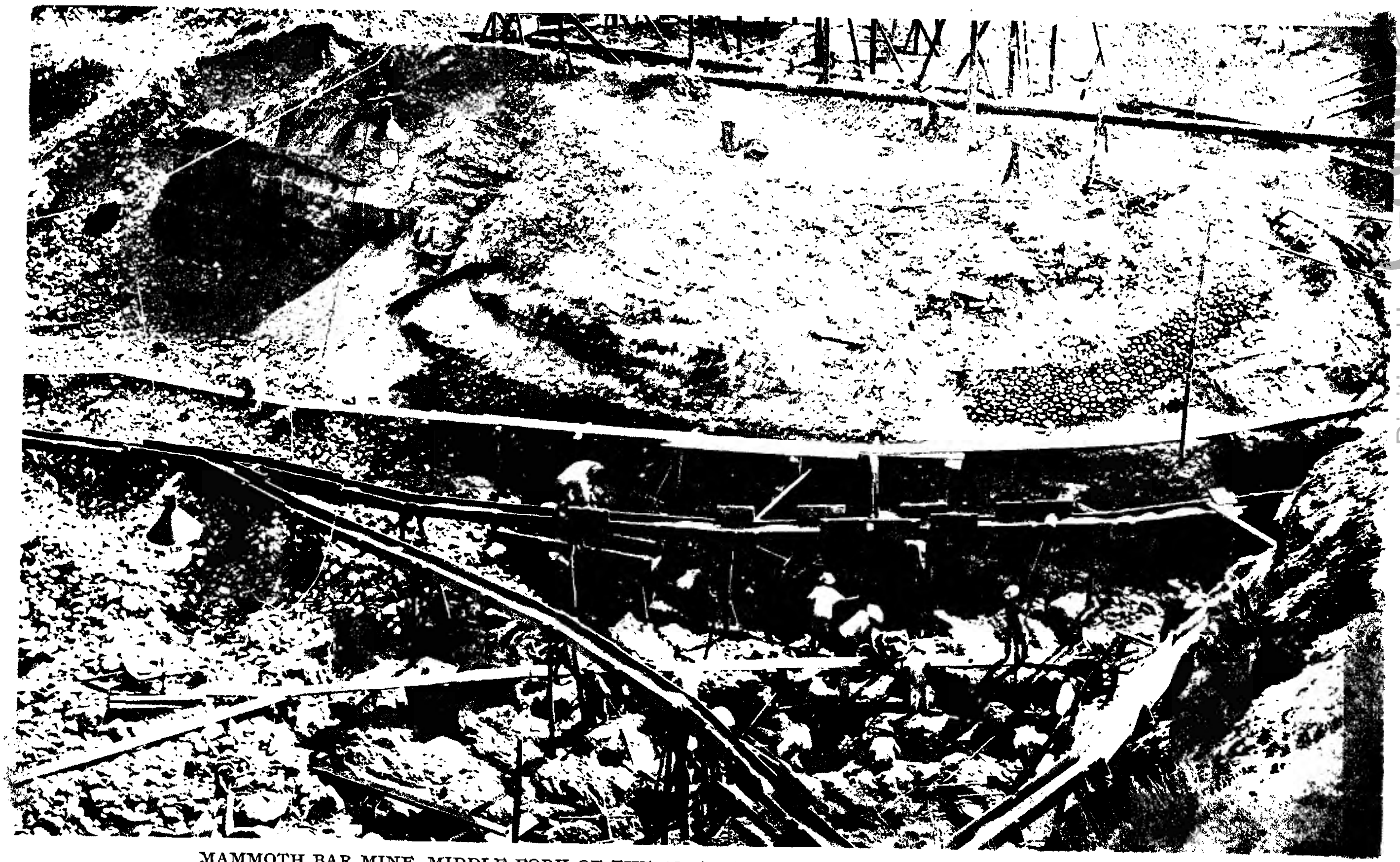
The Mammoth Bar Mine in Placer County has been successfully exploited by means of an open pit, working through elevators, after unsuccessful attempts for thirty years to mine the same ground by drifting, and it is to this mine more than any other that the credit of demonstrating the utility of these machines is due. Two views of the mine are given, illustrating better than verbal description the method of mining. The pit excavated in sixty feet depth of sand and gravel is now very large and has increased the facility of working. Instead of sweeping all the top dirt through the elevators to the dump, it is sluiced back on worked-out ground, and only the pay gravel washed into the sump, at a considerable economy of water and time. This mine uses four hundred inches of water under four hundred and fifty feet head for its elevators; but its experience has demonstrated that larger elevators and a larger supply of water would be still more economical, as the cobbles now moved by hand labor, slowly and expensively, could be then handled by the elevator rapidly and cheaply.

RIVER MINING.

Concerning the general proposition of river mining, it is subject to great uncertainty in the matter of ascertaining whether or not the particular ground it is proposed to exploit has ever been worked or not. Purely surface indications cannot be depended on, and the period of general activity in this branch of mining is now so long past that there is little or no reliable information possible from residents of the locality. But though the river-beds may have been worked over once years since, the tailings from



MAMMOTH BAR MINE, MIDDLE FORK OF AMERICAN RIVER, PLACER COUNTY.
Showing working pit, elevators, sluices, electric lights, etc.



MAMMOTH BAR MINE, MIDDLE FORK OF THE AMERICAN RIVER, PLACER COUNTY. MINING IN PIT.

hydraulic and drift mines have replaced much of the gold that had been taken out. By means of elevators and large heads of water, it will prove profitable to work over these tailings in many of the larger rivers. Again, the winter flood waters are constantly working these tailings down stream and with them considerable amounts of fine gold. It would not, I think, prove unprofitable to put undercurrents in the rivers at points where they can be protected from washing out. The yield, of course, is not large, but neither is the expense connected with this kind of plant. Another method of work which is economical is the construction of a bedrock cut, paved with riffles, through which the great volume of the river and tailings are carried by the winter floods, the sluice being cleaned up in low water. This last described method of mining is rather more applicable to the smaller rivers and cañons where there is a high grade than to the large, wide rivers, but is sometimes of assistance in the latter in cleaning off the top ground of a pit.

SLATE QUARRYING.

A NEW BUSINESS DEVELOPING IN CALIFORNIA.

The essentials of the slate of commerce, such as is used for roofing, billiard beds, mantels, blackboards, tilings, urinals, caskets, grave covers, steps and risers, boxes, wainscoting, water tables, sills and lintels, trimmings for buildings, and many other purposes, are hardness and toughness.

When too soft the stone will absorb moisture, the nail holes of the roofing slate become enlarged, the slates loosen, and require replacement; also, if too brittle, the slate breaks under the weight of a man. When a hole is punched, no tenderness in the material or tendency to enlargement of the opening should be seen. Struck with the knuckles a good slate gives out a sharp, metallic ring. Color is not a reliable guide in estimating the durability of a slate. Black varieties are not in favor; the general impression is that they have not the necessary durability. Dark blue, bluish black, purple, gray, and green are the common colors; some of the purple slates carry spots of light green, which, by the way, do not injure their durability, but the grade is lowered by lack of uniformity in color.

In judging of the quality of a slate by the eye, a great deal of experience is required. The following tests are recommended:

First—Weigh the dry slate, then immerse it in water for twenty-four hours; take it out, wipe dry, and weigh again; the increase in weight will be the amount of water absorbed.

Second—Place the slate on its edge in water so that half the surface is covered; if it be of poor quality, moisture will creep by capillary attraction into that part of the slate above the water line, but it will not do so in a good slate.

Third—Breathe on the slate, and if a strongly marked argillaceous or clayey odor is detected, it is safe to assume the slate will disintegrate easily under atmospheric influences.

Dark veins running through the slate are objectionable, as they are liable to split along the line of the best resistance—nearly always found to be in the course of this vein or streak.

Crystals of iron pyrites should also be suspected (particularly when present as marcasite or white iron pyrite), which oxidize very quickly when exposed to moisture and the air.

The ordinary cubiform, brassy, yellow iron pyrites have much greater power of resistance to meteorological influences than the marcasite. They have been found in the atmosphere of Glasgow unaltered after an exposure of one hundred years.

A building in England was recently torn down, upon which slate had been laid, when it was first built, over one hundred and three years previous. The slates were found in good condition, and were relaid on a new edifice.

Practical experience has already developed the fact that slate will last upon a roof seventy-five years without any deterioration that can be noticed, either in appearance or quality.

ROOFING SLATES.

The slate most in demand for roofing and other purposes, mentioned at the outset of this article, is a clay-rock of great compactness and very fine grain.

Originally it was a deposition from water in which it was held in suspension; and, although deposited in layers, it has, under the influence of heat and compression, experienced marked changes, one of the results being that it will not divide along the planes of its bedding, but splits readily on what are called "the planes of slaty cleavage." This facile cleavage is the essential characteristic of good slate, as it enables the mass to be subdivided with thin sheets with perfectly smooth surface, and thus forms a comparatively light and impervious roof covering. It is of record that a piece of California slate, one inch in thickness, was split into more than thirty layers. The finest slates are found in the Welsh quarries.

EL DORADO SLATE.

The only quarries now being worked in the State are those of the California Slate Company in El Dorado County, at Chile Bar, two miles and a half from Placerville, on the county road leading from that place to Georgetown; the American River runs through one corner of the company's property. The first quarry employs sixty men at present, and the managers intend to double that number when the weather settles. Samples of this slate have been placed in the Mining Bureau, and experts, following the tests given in this article, pronounce it of good quality.

The slate deposit, so far as can be determined by surface indications and openings actually made, is a large one. These openings are near both the northern and southern boundaries, and also intermediate; in each, slate of good grade has been found. The layers of the deposit trend in a northerly and southerly direction, varying from a line due north and south by only a slight angle, and stand nearly perpendicular, with an inclination west. The qualities of the slate are said to be the desirable ones of tenacity, elasticity, moderate hardness, and perfect cleavage. Another quarry was opened on this property in May, 1889, from which roofing slate in considerable quantity is being taken. The new California Theater, recently built in San Francisco, is roofed with slates from these workings, and many contractors for new buildings in that city, as well as other cities in different parts of the State, have accepted the material for the same purpose. Slate quarrying is a comparatively new industry in California, but as the El Dorado article appears to be coming into general use, it is safe to predict that in course of time it will be an important one. An opinion recently expressed in regard to the enterprise is, in effect, that by enlarging the openings and equipping the workings with machinery, a thousand "square" of roofing slate per month can be produced and put on board cars at Placerville at a cost not exceeding $3 50 per square.

THE VALUE OF FOSSILS AS INDICATIONS OF IMPORTANT MINERAL PRODUCTS.

By Dr. J. G. Cooper.

In the "Catalogue of California Fossils," compiled in 1887-8, I referred to the connection between them and mineral products, as an important reason for recording all localities in which each formation occurs. There is no doubt that if more had been known of the different geological formations of this coast, and their productions, in the earlier years of mining, much useless and expensive work might have been prevented, where prospectors lost their all in vain search for minerals, which did not exist in paying quantities.

Dearly bought experience and scientific research have now shown us how far paleontology may serve to guide economical geology on this coast, and I propose herewith to give the results. On account of local peculiarities these do not always agree with such experience elsewhere, but they are no less valuable for workers on this coast. I do not attempt here to enumerate all the useful minerals, etc., of each formation, but only those known to exist in sufficient abundance to pay for working. It is evident that as there is no uniform thickness of any formation, older strata of different geological age may be found at any depth, while a later one is being worked. Therefore, the superficial occurrence of fossils of any one age is a guide to the mineral products only as far as surveys may prove that the formation extends downward. This usefulness may often be destroyed where volcanic or metamorphic changes have altered the lower strata, a very common occurrence on this coast. As nearly all elementary minerals must have been derived originally from the oldest rocks forming the earth's crust, and have been deposited in the stratified rocks containing fossils by aqueous and volcanic forces, they must exist in all of the formations to some extent, but only in certain ones in workable quantity or condition.

A. RECENT AND QUATERNARY STRATA.

It is as yet impossible to define the dividing line between these formations on this coast, since human remains are found at least as far back as the beginning of the quaternary, and nothing defining the end of the glacial epoch has been observed.

The superficial and rarely solidified formations are everywhere included in these strata, and the fossils they contain are chiefly of living species, the proportion of extinct forms determining the relative age of different beds. Since fossils of older formations are sometimes found scattered loosely in the more recent, though generally determinable as erratics, it is necessary to obtain numerous specimens to ascertain their perfect condition and true positions. This is especially true of those found in the much-disturbed gravels and lavas of the Sierra Nevada.

The mineral products of these strata are, first, those of placer and some hydraulic mines, viz.: gold, iridium, platinum, diamonds, sands for glass and mortar, clay; second, mineral or sea waters and contents: iodine, bromine, potash, soda, salt, magnesia, borax, alum, copperas.

The study of soils and agriculture is also founded chiefly on these superficial strata.

B. VOLCANIC PRODUCTS.

These, while partly formed by the action of igneous as well as aqueous forces, and containing minerals different from those of the usual stratified rocks, are on this coast so intimately mixed with the latter that they must be considered with them and often contain fossils of all ages more recent than the cretaceous. The action of hot water heated by volcanic dikes or the fires beneath, have also filled much of the older strata with mineral veins, and metamorphosed the rocks as late as the miocene almost beyond recognition in some places.

The only valuable minerals directly derived from volcanic outbursts are sulphur, basalt, lava, travertine, and other forms of building materials. Other igneous rocks will be mentioned among the archaean formations.

C. TERTIARY FORMATIONS.

The line of division between these and the quaternary is usually shown by more complete solidification, but is sometimes only definable by the greater proportion of extinct species of fossils, and is still quite undefined in some parts of California.

The mineral products in the Sierra Nevada are those of most hydraulic and drift mines, mentioned as quaternary also. In the Coast Range there are added the organic products:

Lignite, asphaltum, petroleum, infusorial sand, marl, phosphates, nitrates. Building sandstone is also of value.

The products called organic, all derived from animal or vegetable decomposition, show the important part played by the fossils which have formed so great a part of these later strata, which compose a very large proportion of our Coast Ranges. They also produce the most fertile soils, as compared with those derived from older rocks only.

D. CRETACEOUS FORMATION.

While there is still some uncertainty whether the eocene tertiary is not included in the division called "Cretaceous B," on account of the absence of a well defined line of separation, the fact is still established that all the fossils of that division are distinct from any living species. This itself forms a good line of separation, and may be proved to be more important than the old division between eocene and cretaceous. In this fossiliferous portion, or between divisions "A" and "B," is included the lignitic coal, of better quality than the tertiary lignite.

Large portions of the Coast Range, supposed to be of cretaceous age, have lost all traces of fossils and of stratification, but can be connected where they unite with the unaltered strata. These metamorphosed regions contain the most valuable mineral products of the range. Thus the infiltration of the stratified rocks, while destroying organic contents, has substituted veins of various minerals deposited from heated sea water, or of volcanic origin.

Alabaster, antimony, aragonite, cement rock, chromic iron, graphite, gypsum, limestone, magnesite, manganese, marble, mercury. Lithographic stone may be expected to occur in this or the following formation.

E. TRIASSIC AND JURASSIC STRATA.

On account of the scarcity of fossils so far found in these rocks, which are chiefly the Sierra Nevada slates, their exact limits have not yet been determined, and it is quite probable that they run together in California, on both slopes of that range. There is some reason to believe that these strata occur also in the Coast Range north of Lake County, and perhaps further south, but generally too much metamorphosed for identification. Their age being greater than that of the preceding strata, they are more metamorphosed and broken up by volcanic outbursts. The effect of this is shown by their containing more metallic elements, and they constitute the most valuable of all the California mining regions, producing gold, silver, copper, platinum, nickel, zinc; also, roofing slate and many building stones.

F. CARBONIFEROUS LIMESTONE.

The small exposure of this formation on the west slopes of the Sierra Nevada is identified only by its fossils. As it is found also in Nevada, chiefly as limestone or marble, containing good but thin beds of coal in the unaltered strata, this may also be expected to occur in southeastern California. In that part of this State there is much more limestone, probably of this age, containing silver-lead ore, with some gold, and other less valuable minerals. Being mostly metamorphosed and fossils rare, the value of this, and probably of some still older formations not yet identified in California, depends on the metalliferous veins, and chiefly the metals above named, not on the organic products, coal, etc., which are so important in the same formations in other parts of the world. They contain more or less of the same minerals found in all the later formations older than tertiary, but not usually so profitably worked as they can be nearer the coast.

G. ARCHAEAN ROCKS.

The crystalline and azoic rocks, sometimes partially stratified, constituting the lowest bedrock or crust of the earth, form much of the Sierra Nevada and portions of the Coast Ranges. They are distinguishable from the metamorphic and volcanic rocks by their mineral structure, and from the others by absence of fossils.

The valuable metallic veins contained in these rocks seem to have been formed in the same way as those in later metamorphic rocks.

Though containing a great variety, if not all, of the elementary minerals, these are usually so much diffused, or perhaps so deep down, as to be unprofitable for working, except the following to a limited extent: Gold, tin, iron, asbestus. Feldspar (kaolin), lithium, and titanium may also become of value.

Granite, gneiss, and porphyry are the most important building stones found in the archaean rocks, together with other products of ancient volcanic outbursts.

While the relation of valuable products to geological formations may be now considered as well established, as far as those here considered are concerned, many other minerals will doubtless be found to be valuable as the country becomes developed, and careful surveys are needed to show where these may be most profitably obtained.

CLAYS.

By W. D. Johnston, M.D., Chemist State Mining Bureau.

Under this general term many varieties are included which are more or less used in the arts and manufactures. The characteristic property of clay, and one possessed by no other mineral substance, is that peculiar condition known as plastic. The ingredients of clays, to which this feature is due, is a hydrous silicate of alumina. When pure it is of a snow-white color; to the touch it has a soft, unctuous feeling, and is very easily broken; it adheres to the tongue, and gives off a singular smell when breathed upon, which has been designated the argillaceous odor. When moistened with water, a considerable quantity of the fluid is absorbed, and upon manipulation the clay speedily passes into the plastic condition, which enables it to be molded into many different forms.

The purest clay found in nature is known by the technical name of kaolin, or China clay, a word derived from Kauling, the name of a mountain in China, where this earth was first discovered. The Chinese are entitled to the credit of first utilizing kaolin in the manufacture of vessels for general domestic purposes. For many years the finer kinds of porcelain were imported from China, and the character of the materials used, as well as the method of manufacture, were kept secret until the advent of some Jesuit priests, sent there as missionaries. For over two centuries Europeans were thus baffled in their attempts to learn the secret of the materials used in the manufacture of Chinese porcelain. The information given by the cunning celestials was that the ware was manufactured from eggshells, seashells, and other matters which lay buried deep in the earth for a period of one hundred years. The ware naturally took its name from the country whence it was brought, and when a similar clay was discovered in other parts of the world, it was still called by the original name, kaolin, or China clay. The word "clay" is derived from the Anglo-Saxon Claeg; Dutch, Klei; German, Kleben, which means "to stick."

Dr. George A. Koenig, Professor of Geology in the University of Pennsylvania, who has made special microscopic investigations, states that kaolin is composed of minute particles, loosely aggregated, and invisible to the naked eye. Magnified eleven hundred diameters, these infinitesimal particles look like globules, and are not very unlike fish roe in appearance. Prior investigators had concluded that the kaolin material was crystalline, but Dr. Koenig, arguing from the lack of effect on polarized light, is satisfactorily convinced of the absence of anything resembling crystalline structure. He lays stress upon their similarity to globules of starch, as they are capable of absorbing water, of enlarging and passing into a plastic paste, the extreme mobility of which is easily accounted for by his assumption of the rounded form of the ultimate particles. Their extreme minuteness—less than the one ten thousandth part of an inch—enables this substance to remain suspended in water for a long time. River water, for days after a rainstorm has ceased, will have a peculiar milky opalescence due to the presence of these minute globules. The crystalline components of clay are generally designated as sand, and consist of fragments of different mineral species, such as quartz, feldspar, mica, hornblende, tourmaline, magnetic iron, etc. These crystalline substances may be found in particles not much larger than the globules of kaolin proper, and thus remain suspended with it in water, while the coarser sand settles quickly, and may be separated from the kaolin and the finer crystalline materials. The contamination of the kaolin with these fine crystalline particles misled former observers and gave rise to the erroneous deduction that kaolin itself had a crystalline structure.

There are also compounds present in clays which often have an important bearing in determining their economic value. Among these are iron pyrites, sulphate of lime, carbonate of lime, dolomite, carbonaceous and bituminous matter, oxide of iron, etc. To these are due the various colors which characterize ordinary clays, and which vary in their effect upon the material when it is applied for technical purposes. In geological works clays are divided, in accordance with their occurrence, into primary and secondary deposits. From their physical conditions of structure and chemical composition, clays are technically separated into various classes, expressed by the words fat, long, lean, short, plastic, argyllites, clay-slates, marls, and loams.

For a proper understanding of the conditions expressed by these various words it will be necessary to consider the origin of clays. The primary rocks of which the earth is composed, and underlying all other rocks, are made up principally of three minerals—quartz, feldspar, and mica. Quartz is pure silica, exceedingly hard, and not acted upon by atmospheric or chemical agents at ordinary temperatures. Feldspar is composed of at least four elements—potassium, aluminum, silicon, and oxygen. These are in a state of chemical combination, and may be represented by the formula, $K_2Al_6Si_6O_{16}$. At times the potassium is replaced by sodium more or less completely, and in other cases the potassium may be replaced by calcium. The feldspathic material is nearly white, glassy in appearance, capable of cleavage, and but little softer than quartz. The third constituent, mica, is in composition made up of the same elements as feldspar, but contains, in addition, iron and magnesium. These three materials are the chief constituents of a number of primitive rocks. When, in forming a rock, they have a more or less parallel arrangement, it is termed gneiss, and the structure is called schistose or slaty. When these three constituents are more regular in their distribution through the rock mass, it is termed granite; and when feldspar predominates they form porphyry and trachyte.

In the variety of feldspar called albite, the potassium is replaced by sodium. The potash-feldspar (orthoclase), and the soda-feldspar (albite), are often seen together as constituents of granite, as in that of which Pompey's Pillar is made. Labradorite, a feldspar in which calcium and sodium have replaced the potassium, is a beautiful variety, of pearly luster, often exhibiting a play of blue, yellow, green, and red colors. There are other varieties, such as anorthite, in which calcium has entirely replaced the potassium, and oligoclase, in which both calcium and sodium are present, but the sodium predominates. The common feldspar is again subdivided into classes. Among these are adularia, the white or colorless subtransparent specimens, and sanadin, or glassy feldspar, which includes transparent vitreous crystals found in the trachytes and lavas.

The investigations of geological chemists have demonstrated that all the sedimentary rocks have been formed from a rearrangement of material derived in the first place from the disintegration of the feldspathic rocks, which must have been much more rapid at that period of our planet's life, when the water first found a lodging-place upon the heated earth, and when the primitive atmosphere was heavily charged with carbonic acid gas.

Observations upon feldspathic rocks show that under the action of the atmosphere the exposed surfaces become covered with a thin, soft, white, and opaque crust from this decomposition. This is particularly noticeable in those feldspars where the potassium has been replaced by calcium and sodium. In this change there is formed a soluble alkaline silicate, which, passing into solution, is probably in most cases decomposed by calcium and magnesium carbonates, giving rise to silicates of these bases, and to sodium carbonate. A gradual process of this kind is constantly going on in the feldspathic minerals which constitute so large a proportion of the sediments of many formations, and in strata deeply buried this decomposition is probably hastened by the elevation of temperature due to the internal heat of the earth. That carbonic acid gas is not necessarily an essential element of this decomposition has been proved by the experiments of Bunsen and Damour, who found that distilled water at temperatures below the boiling point of water would take up from feldspathic minerals comparatively large amounts of silica and alkalies.

From chemical and mechanical considerations it is evident that the major portion of the insoluble residue left after this decomposition of feldspathic rocks, cannot be pure kaolin, but must necessarily be a mechanical mixture of it, with more or less partly altered feldspar, and the most easily decomposed materials of the original rock, with a certain proportion of quartz. This material in the past has been deposited in the depressions on the earth's surface, and in changes due to the unstable condition of the earth's crust was subjected to heat and pressure and became consolidated, forming a true rock. This, in turn, was upheaved by the internal forces of the earth and was again subjected to disintegrating influences.

Among the materials forming clay are various minerals containing protoxide of iron; these, under atmospheric action, become altered to higher states of oxidation, and give to the clays all shades of color from the finest yellow to the deepest brown; they also explain why pure white kaolin is so seldom found. This disintegration of the primitive rocks and the rocks that were again formed from them, going on through millions of years, has resulted in a deposition in nature's settling-tanks of vast amounts of clay of more or less purity. They occur in beds of varying thickness, and follow the stratification in dips and strike of the underlying rock. These primary deposits of clay have been rearranged many times by subsequent geological changes, which have had effect in redepositions of these clays, and sometimes resulted in the purification of the clay mineral proper, and at other times in its degeneration.

The older clays have been compressed and hardened, and have formed slates. These primitive slates, when finely ground and placed in contact with water, will, after a time, become plastic clay. Between the hard slates of the older geological period and the softer slates of recent geological formations, we find a marked difference in texture and adaptability for technical purposes.

This power to pass, with water, into a dough-like plastic state decreases in proportion as a sandy element is mixed with the clay. It is strongest in the "fat" and weakest in the "lean" clays. A "fat" clay dries very slowly and unevenly, and the molded objects will warp and crack in drying. Aron found that the "linear shrinkage" does not correspond with the drying of the clay, as might be expected, but ceases when followed up to a certain point, which he designates as the "limit of shrinkage." The water evaporated up to this point, he terms the "water of shrinkage;" the remainder of the water lost, until the weight of the sample remains constant at a temperature of 130 degrees C., he calls the "water of the pores;" the sum of both is total water.

If we assume that the minute particles of clay substance possess the round shape claimed by Dr. Koenig, this behavior is easily explained, as the "water of shrinkage" envelops these particles, and upon evaporation will allow them to approach, until each touches the other at six points on the surface. The intervals between all other points will still be filled with "water of the pores;" and its evaporation cannot produce any shrinkage of the clay. Now, Dr. Koenig claims that it is an important rule for the potter that the number and sizes of the pores are independent of the water contained in the clay, and is constant for all plastic clays; and, further, that the cubical shrinkage is equal to the volume of water lost by evaporation up to the limit of "linear shrinkage." Aron contends, further, that if the purest clay is mixed with fine quartz sand, the shrinkage will increase up to a certain point, which he terms the "point of greatest density." From this point the shrinkage decreases again, with increasing leanness, while the porousness increases. On submitting clay to a red heat, two molecules of water are driven off from the silicate of alumina at that temperature, and, as a result, the clay shrinks a second time. This is known as the "fire shrinkage," and can be neutralized by the addition of finely divided sand, and may even be made to produce a slight expansion. Finely pulverized chalk is also an excellent material to counteract the "fire shrinkage" in clays.

The proximate constituents of kaolin are alumina and silica. Pure alumina resists fusion at the highest temperature which can be obtained in the blast furnace. Quartz in the crystalline state, when exposed to the same temperature, has the terminal points of the crystals faintly rounded, and its surface becomes coated with a very thin glassy glaze; hence both substances are practically infusible. It is a general law in chemistry that the alloys of metals will have a lower fusing point than the arithmetical mean of the individual fusing points of the component metals. The chemical union of silica and alumina forms no exception to this rule—the compound glazing at the temperature at which wrought iron melts.

The experiments of Bischof and Richter show that the infusibility of the compound is increased with the percentage of alumina. To determine the effect of fluxing agents, Richter made the following experiment: The chemical union of one part alumina with two parts silica was obtained by subjecting the mixture to the highest heat of a blast furnace until partial fusion proved that chemical union had resulted. This product was finely pulverized and four equal portions of it were intimately mixed as follows: to one part was added 4 per cent of magnesia, to the second part, 4 per cent of lime, to the third, 4 per cent of sesquioxide of iron, and to the last, 4 per cent of potash. These four mixtures were made into small cylinders and exposed to the same heat of the blast furnace. The magnesian mixture had melted to a glassy slag, while the remaining three (lime, iron sesquioxide, and potash) had been only partially fused, so that he was justified in drawing the deduction that their fusing points correspond in ascending series to the molecular weights of these oxides: $MgO,40$ $CaO,56$ $\frac{1}{2}(Fe_2O_3)$, 80 $K_2O,94$. This result has been formulated by Richter into the following law: Equivalent quantities of different fluxing oxides produce the same effect upon the fusibility of a clay; for example, if analysis had shown that a certain clay contains magnesia three-tenths of one per cent and that another contains potash seven-tenths of one per cent, we could expect with certainty that both would have the same resisting power to the action of fire. According to the same observer the presence of these several substances in the clay does not influence the effect produced by each singly, their fusibility increasing only with the higher sum of their combining weights. As one of the most important uses of clays to the manufacturer is their power to resist high temperatures, the significance of the deduction from this experiment is obvious.

FIRE-BRICK.

As the name indicates, the requisite property in a fire-brick is its capability of resisting high temperatures. In composition, these bricks consist of a very nearly pure clay, or of a mixture of pure clay with clean sand; rarer kinds are met with which are composed of nearly pure silica, bound together by a small proportion of clay. Objectionable ingredients are oxides of iron, if the percentage exceeds 6 per cent; and magnesia, lime, soda, or potash, when their combined weight exceeds 3 per cent.

The fire-bricks most infusible are made from the Welsh Dinas clay, which contains 97 per cent silica and 3 per cent other constituents (alumina, 1.39; ferrous oxide, 0.48; lime, .019; potash and soda, 0.20; water, 0.50.)

In constructing lead smelting furnaces, experience has demonstrated that fire-bricks made from clay (kaolin) united with clean sand are preferable.

In the manufacture of retorts for gas works, the melting pots of the glass factories, the muffles and crucibles of the assayer, fire-clay must be of excellent quality; and great care has to be exercised in molding, and particularly in baking.

Fire-clays are usually found in the coal measures just beneath the seams of coal.

A good quality of fire-clay was discovered in the Black Diamond Coal Mine, from which, years ago, large quantities of fire-brick, crucibles, and stoneware were made by the Albion Pottery at Antioch.

An exceptionally good quality of fire-clay, from Carbondale, Amador County, has been analyzed this year in the laboratory of the Mining Bureau. The analysis is No. 8 of the California series, given under "kaolin."

The "alum-bearing" clays contain aluminum sulphate, which, when combined with potassium sulphate, forms the useful salt, alum. In these alum clays the sulphuric acid has been derived from the oxidation of the sulphur in iron pyrites, the iron being left in an oxidized state and the sulphuric acid united with the alumina. Alum, in the common use of the word, is the sulphate of alumina, and potash, and water of crystallization: Aluminum sulphate, 36.2; potassium sulphate, 18.3; water, 45.5. If the potassium sulphate is deficient, it is made up by the addition to the leachings from the burnt alum shales. When found in nature, it forms the mineral called kalinite; when ammonia replaces the potash salt, the mineral is tschermigite. These minerals and the native soda alum (mendozite) have a marked resemblance, both in taste and appearance. Alum has been found in incrustation ten miles north of Santa Rosa (4,468), and near Newhall, Los Angeles County (4,404). Alum slate occurs near Auburn, Placer County (4,249), and the exhibit in the Mining Bureau Museum (4,250) is alum crystallized from it. Alum, in thick incrustations, is found at the Sulphur Bank Quicksilver Mine, Lake County, in considerable quantities (1,108), and has been reported as occurring at Silver Mountain, Alpine County; Howell Mountain, Napa County, and at numerous localities in the State, as a slight incrustation on the rocks.

The ordinary yellow brick clays contain iron in the state of oxide and carbonate chemically combined with water, forming what are known in chemistry as hydrates. The expulsion of this water in the process of burning imparts a red color, due to the conversion of the hydrated oxides of iron into the anhydrous form. The principal constituent in brick clay, and that upon which its plasticity depends, is the chemical combination of silica and alumina, more particularly described under the head of "Kaolin." This constituent used alone shrinks and cracks in drying, warps and becomes very hard when baked. Silica is also present in nearly all clays in an uncombined state, such as sand. A proper proportion of sand prevents cracking, shrinkage, and warping, and furnishes silica necessary for a partial fusion of the materials which increase the strength of the brick. The sand also makes the brick more shapely and equable in texture; but an excess of sand in clay renders the brick made from it too brittle. A small quantity of carbonate of lime has a beneficial effect upon brick clay in two ways—it lessens the contraction of the newly-made bricks in drying, and acts as a flux in the kiln by the formation of silicate of lime, which binds the particles together. It is evident from this that an excess of carbonate of lime in the clay would cause the brick to melt and lose its shape. Iron pyrites in a brick clay are objectionable; also the presence of carbonaceous matter to any considerable extent, as a black discoloration, similar to that produced in bricks in proximity to chimney flues, is likely to occur.

Common salt is nearly always present in minute quantities in clay. In that near the seashore the amount is apt to be so great that bricks made from it are certain to be of a poor quality. Salt melts readily and glazes the outside of the bricks, and the heat cannot be raised or maintained sufficiently long to burn them to the core, or into good, hard brick; as a consequence, they are soft and, from the presence of the decomposed salts of magnesia and soda, are always damp, owing to the tendency of these salts to absorb moisture from the atmosphere. The presence of the alkaline carbonates in clay to any notable extent, prevents its being used as a brick clay, the alkali causing the material to melt readily.

Brickmakers divide clays into three classes:

First—Plastic or strong clays, which are chiefly a silicate of alumina; these are called by the workmen "foul clays;" a more fitting name, and one by which they are also called, is "pure clay."

Second—Loams or mild clays are those in which there is a considerable proportion of sand intermixed.

Third—Marls or calcareous clays are, as their name indicates, clays containing a notable quantity of carbonate of lime.

"Malm" is a name applied to an artificial marl, made by adding to and intermixing with the clay a proper proportion of carbonate of lime.

As a general rule, a clay fit for the manufacture of a first class quality of brick is not met with in nature. There is most always a deficiency of sand or lime. A good brick clay is one that contains sufficient fusible elements to bind the mass together, but not so much as to make the bricks adhere to each other or become vitrified. Such clays contain from 20 to 30 per cent alumina, and 50 to 60 per cent silica, the remainder consisting principally of carbonates of lime and magnesia and oxide of iron.

Pure or "foul clays" are sometimes used for bricks without any admixture of substances to improve the material. Bricks thus made are generally deficient in weathering qualities. The color of bricks depends upon the composition of the clay, the character of the added ingredients, the temperature at which they are burnt, and the amount of air admitted to the kiln. A clay free from iron will burn white, but, as a general rule, carbonate of lime (in the form of chalk) is added to produce white bricks. The presence of iron oxides produces a tint which varies from light yellow to dark red, the intensity of color increasing with the greater quantity of the oxide. If 8 or 10 per cent of iron oxide is present, and the brick becomes intensely heated, the red oxide of iron combines with the silica and fuses, producing a dark blue or purple color. The presence also of a small quantity of oxide of manganese, in addition to the oxide of iron, will cause a material darkening of the red tint. By the presence of small quantities of lime the red color of iron oxide is modified to a cream tint, while larger quantities make a brown color. Magnesia also changes the red tint to yellow.

For general purposes bricks may be divided into three classes. First class, building brick. These should be free from cracks and flaws, and devoid of lumps of any kind. They should be hard, and so thoroughly burnt that incipient fusion has taken place all through the brick. This may be determined by scratching a fractured surface. A knife will hardly make an impression unless the brick is underburnt. A brick thoroughly burnt and free from cracks will give a clear, ringing sound when struck.

Brick of fair quality will bear a compressive force of three thousand pounds to the square inch. Very soft brick will yield at as low a pressure as three hundred and seventy-five pounds, while the best quality of pressed brick will withstand a compressive force of six thousand pounds. Masses of brickwork crush under smaller loads than do single bricks, and good authorities claim that first quality brick laid in the best cement should not be subjected to more than one hundred and forty pounds to the square inch as a permanent load.

Second, cutters or rubbers, which are purposely made soft to be readily cut with the trowel, and then rubbed to a smooth face and the required shape. Of necessity, bricks of this character are of too soft a nature to be used where there is much exposure to the weather.

Third, underburnt or misshapen bricks, known to the trade as "grizzle" or "place" bricks, and also termed "samel" bricks. These are always soft inside and very frequently soft on the outside also. They are liable to decay, and are unfit for good work.

The character of bricks made and used in early days in San Francisco is strikingly exemplified at the present time, in the ricketty condition of the old City Hall and various buildings, the inferior materials of which have necessitated their demolition. The absence of hard frosts in that city and neighborhood has been a very important factor in disguising the faulty constitution of our pioneer bricks.

POTTERY.

The word "pottery" is supposed to be derived from "poterion," the drinking cup of the Greeks, and to have been transmitted by the French word "poterie." The term is applied to all objects of baked clay.

One of the earliest manifestations of the dawn of intelligence among our remote ancestors was in the construction of rude cups and vases from clay. Possibly the first indication of its plastic nature was noticed by the impression of their bare feet where the clay had been softened by rain, and these pieces retaining the impression were accidentally or purposely subjected to the action of fire and found to retain their shape, change their color, and this likely gave rise to the idea that this material could be utilized in the manufacture of vessels to hold solids or liquids. The savage tribes of the present day make, with their rough appliances, articles of pottery which have the same general form and fashion of those made by the most ancient race who have left us fragmentary traces of their crude clay vessels. The potter's art manifestly had its origin in the wants and necessities of man's common nature, which, being the same in all countries, led up to similar inventions.

The art of pottery orginated spontaneously and independently among many different races. Similarities in forms, and even in the manner of ornamentation, are noticed in these primitive emanations from the potter's hand. The points of resemblance seen in comparing the forms found in the old world with those found in the new do not prove the identity of the origin of the different races, but they show that the workings of the human brain in widely scattered nations lead to similar and almost identical forms of work. Much light has been shed upon ancient history by the fragments of pottery and tablets of baked clay exhumed from the earth. In the manufacture of pottery, and in its varied uses, history indeed seems to repeats itself; for in our day we find it, as in the earliest centuries, occupying a prominent place for domestic and ornamental purposes, as well as architectural, irrigation, drainage, and sanitary uses.

As a fire preventive and fire-proof material, there is nothing yet discovered that will take the place of pottery. Indestructible, and resisting alike the wear and tear of the elements and the ravages of time itself (a virtue as well known to the ancients as to ourselves), it has been the means of aiding historical research, clearly defining the domestic manners, and contributing greatly to the disentanglement of the history of nations long since passed away, and which would have been forgotten but for the everlasting evidence furnished by the potter's art. The extent of the Grecian empire in its palmy days can be traced by the Grecian funeral pottery, which long survived the political existence of the Grecian empire. In like manner the extent of the conquest of the Roman Legions can be deduced from similar forms of Roman pottery. A large portion of what we know of Assyrian history has been derived from the broken clay tablets discovered in Assyria. In ancient Egypt, in the catacombs of Thebes, which are known to be over four thousand years old, a series of drawings have been discovered impressed upon clay, which exhibit the potter's art as practiced at that time, and by which it is proved that the clay was kneaded with the feet, shaped on the potter's wheel, and baked in the oven. In sacred writ we find the expression, "And the Lord said, 'O, house of Israel, cannot I do with you as with this potter? Behold, as the clay is in the potter's hand, so are ye in mine.'" In the stone age remains of pottery, primitive and rude, have been discovered. Most of the urns of this period, in which have been found the ashes of the dead, were made of sun-baked pottery. In the bronze age the remains of the pottery found show that the potter's wheel had been used in its manufacture.

According to Mariette, the Egyptians had glazed pottery, on which the glazing was colored a light blue, as far back as three thousand seven hundred years before Christ. Vessels, urns, armlets, finger rings, and sepulchral figures were made of this glazed clay. Specimens of these various objects are on exhibition in the museum of the Mining Bureau.

Kiln-baked bricks occur only in the ruins of ancient Babylon, and were pressed out of a wooden mold. Some have been found bearing the name and title of Nebuchadnezzar. In the ruins of Babylon it is claimed that original Chaldaic accounts of the genesis and of the deluge have been discovered stamped in cuneiform characters on clay tablets.

The oldest fine pottery made by the Greeks cannot be more recent than the seventh century B. C. Greek pottery has been divided into five classes, corresponding to the stages of the rise, progress, maturity, decline, and decay of the country, and they have been designated as the Egyptian, Archaic, the Beautiful, the Florid, and the period of Decadence.

The Egyptian is so called because the knowledge of the art was obtained from Egypt, and the early forms of ornamentation on the vases were characteristically Egyptian, being those of winged birds and animals.

The Archaic varieties, of human figures, many of them of exceedingly handsome designs; the Beautiful, as the name implies, were still finer works of art, in which finely formed human figures, male and female, were most often the subjects. The Florid, which dates about the third century B. C., is characterized by the vases being much larger in size and very beautifully adorned with human figures, flowers, fruits, and fancy patterns. In the clays and pottery made by the Greek during the second century B. C., and designated as the Decadence, marked inferiority in the beauty of the patterns, the clay material, and style of finish is very noticeable. Vessels of pottery for domestic purposes were in extensive use by the Romans. What is now known as terra cotta was utilized as the bas-relief for interior decorations of their houses; mortuary urns of baked clay held the ashes of the dead. Pliny speaks of the pottery made at Aretium, the modern Arezzo, a city of Tuscany, as being of a superior kind. It is bright red, of the color of sealing wax, and coated with an alkaline silicate glaze. The prevalent form of the work is that of a teacup without handles.

Pottery belonging to the Anglo-Saxon period occurs extensively in England; the specimens were apparently modeled by hand, made of a clay rather coarse in texture, and often not baked. The ornamentations consist of parallel, and sometimes vertical and zigzag lines; on some pieces the spaces are found filled up with small circles and crosses stamped or painted in white. The characteristic peculiarity of the Anglo-Saxon burial urns consists in raised knobs arranged in a symmetrical manner around the upper portion.

In Germany, urns made of a paste of clay and sand, intermixed with white, yellow, and brown mica, have been found along with remains of the Teutonic races. The vessels unearthed in central Germany are more ornamental than those in the north, but the ornamentation was crude, consisting of lines, zigzags, network, semi-circles, and diagonals.

During the darkness of the middle ages that followed the decline of the Roman Empire, the art of manufacturing decorative pottery was entirely lost in Europe. We find it first reappearing in Spain, brought there by the Saracens, who particularly excelled in the manufacture of beautiful tiles, called by the Spaniards "azulejos." These were made of a pale clay, the surface coated over with a white opaque enamel, upon which elaborate designs were executed in colors. The courts of the Moorish palace of the Alhambra were paved with these tiles; but only a portion of one pavement is now left.

From Spain the art of decorative pottery was transmitted to Italy, and the initial attempts there to make glazed earthenware are plainly imitations of Moorish pottery. The first improvement, due to the Italians, was an opaque glazing composed of an oxide of tin, which may be considered as the starting point of majolica ware. Lucca della Robbia, born in 1400, was the artisan who made this discovery. He found that if his figures in clay were brushed over with a glaze of tin oxide, combined with colored substances, an extreme durability was secured. His pottery was exceedingly artistic. The frame work of his compositions generally consisted of a row of small heads, angels or cupids, or wreaths of flowers and fruits. Decorations for church altars, medallions, and bas-reliefs were also manufactured by him.

The taste for decorative ware of the majolica variety quickly spread to other countries, particularly to France, and was there called "Palissy" ware, named after the celebrated Bernard Palissy, who, starting life in poverty and in the face of many difficulties, acquired a taste for experimental chemistry, and taught himself painting by copying the works of the great masters. He became an enthusiastic admirer of the Italian ware, and determined to devote himself to the problem of discovering the composition of their various enamels. For sixteen years he pursued his investigations, being at times in the most dire distress. To provide fuel for his furnace he was compelled to burn up the greater part of his furniture, and even a portion of the flooring of his house. Success at last crowned his efforts, and a few of his first works, adorned with figures of animals and so colored as to imitate nature, sold for such high prices that he was enabled to complete his investigations, and at the same time lay the foundation of his future fortune. The ware made by him was generally ornamented with fishes, frogs, lizards, and plants, such as are found in the neighborhood of Paris. Palissy ware has no preceptible mark, but on many of the pieces with scalloped borders there is a daisy (which in French is "marguerite") as the particular ornament, probably placed there to show Palissy's affection for Marguerite of Navarre.

Holland early became celebrated for its pottery. The principal manufactory was at Delft, hence the product was called "Delft" ware. This was coated with a glazing of oxide of tin; the ornaments were chiefly in blue, and the ware was remarkably light and very hard. In shape it resembled that made in China and Japan, and was sold chiefly to the English. It was passed off on them as being really the article manufactured in China and Japan, but in fact the articles were only excellent imitations.

Germany has long been celebrated for its skill in pottery, the first manufactories being located at Cologne, Coblentz, and other places on the Rhine. One of their products consisted of brown-stone pots known as grey-beards, with the bearded mask on the neck; they also made stoneware jugs ornamented with subjects taken from the Scripture and the various coats-of-arms of the electors and princes of Germany. The drinking mugs were adorned with quaint patterns, around which were inscribed mottoes suggestive of banquets, love, and affection.

The earliest known potteries in England date back to one established at Lambeth in 1640, and one at Fulham shortly afterwards. The Lambeth pottery very soon took up the manufacture of delft ware, making tiles with scenery and houses depicted on the surface in blue. In 1720, the discovery of the use of pounded flint as a constituent of earthernware was the starting point of great improvements in its manufacture. The flint was mixed with sand and white clay and colored with oxide of manganese and copper, forming the products called "agate ware" and "tortoiseshell ware." Glazing with salt was discovered about 1680. White and cream-colored ware glazed with salt was extensively manufactured after 1690, and some of the product was of such fine quality as to almost resemble a porcelain. Wedgwood, in 1773, after numerous experiments, succeeded in making the ware which has since passed by his name. He used sulphate and carbonate of baryta in combination with finely-ground flint and potter's clay, and thus obtained a dense compact paste exceedingly plastic and sufficiently hard after baking to receive a good polish.

The most valuable pieces of Wedgwood ware are the copies of the famous Portland vase, the original of which is in the British Museum. They are composed of two layers of vitrified material, one white and the other blue. The original price of each copy was $250; but now, of course, as copies have grown scarcer, prices have been exceedingly enhanced.

California is peculiarly favored as a center for the manufacture of articles of clay now in use, and the rapidly growing popularity of this class of material, especially for building purposes, is evidenced by the increased output of the numerous potteries throughout the State. By reason of the equableness of our climate, and the length of the summers, work can be carried on to great advantage throughout the year. The exports of manufactured articles have been steadily augmenting, and the increase of our population causes an enlarged domestic consumption. Shipments to Washington, Oregon, Nevada, Mexico, and Texas are of regular occurrence, and so progressive and flourishing appears the industry in all respects that additional capital is being enlisted, and it is destined in the not very remote future to contribute in a most substantial manner to the wealth of the State.

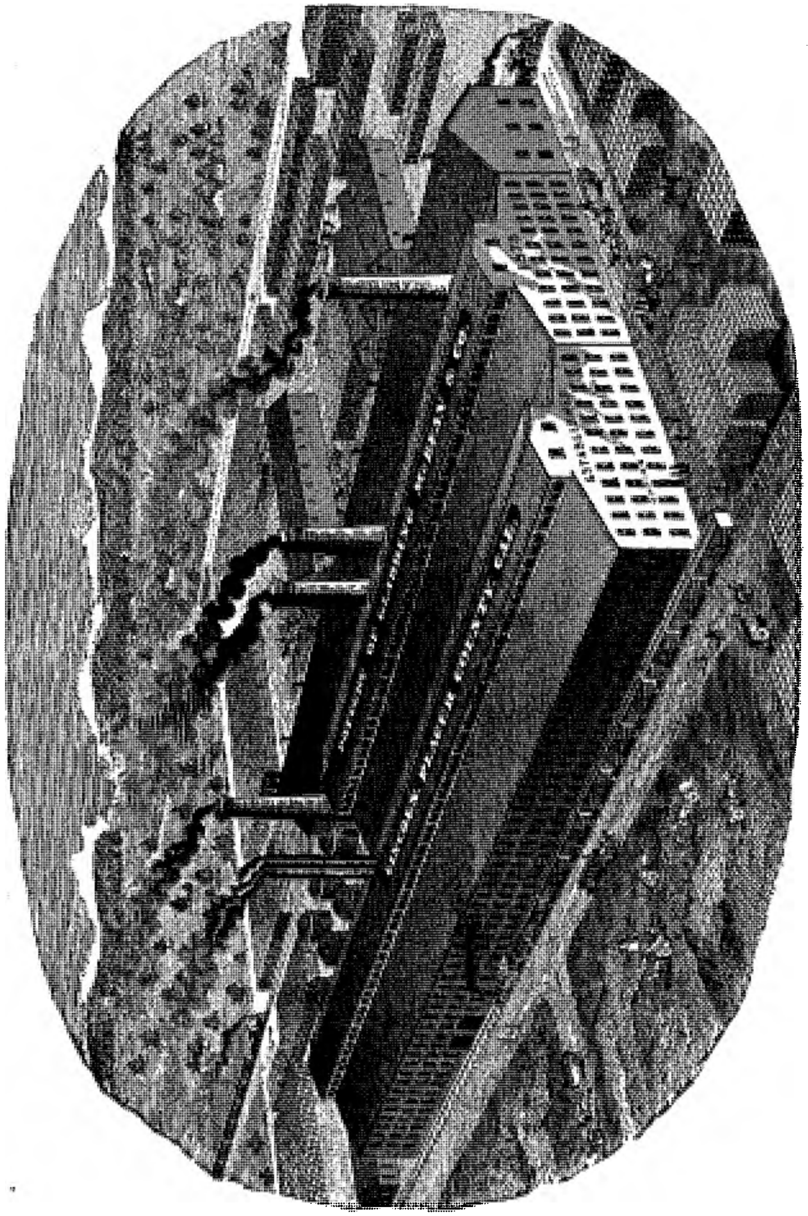
The capital already invested amounts to upwards of $1,000,000, and employment is furnished for many hundreds of people, principally whites, at lucrative wages of from $2 to $6 per day.

Adjacent to railroad communication in various parts of the State, practically inexhaustible beds of clay are found. Lincoln, Placer County, on the Oregon Division of the Central Pacific Railroad; Carbondale, Amador County; Elsinore, San Diego County; Los Angeles, Sacramento, and San Francisco Counties, have all deposits of this material. In the county last named the clay found is of a coarse quality, but when mixed with the better grade shipped from Carbondale, is used in the manufacture of articles of a cheaper and more common character.

Clay beds are also found in various places in the Counties of San Bernardino, Monterey, Inyo, Calaveras, Alameda, Contra Costa, Tehama, Humboldt, Napa, and Sonoma, California, but are generally of the coarser qualities.

There are also to be found in California, in several localities, clays from which a good grade of crockery ware could be readily manufactured, but although once experimented upon in a small way, the enterprise was abandoned, as competition with the eastern and imported goods of this character could not be profitably maintained. The same state of affairs may, in a measure, be said of fire-bricks. While it is an admitted fact that as good a quality can be and is manufactured here, as the imported or English article, still a restrictive influence is laid upon extensive production by reason of heavy importations at so low a rate as to cut off, in a great measure, reasonable profit for the local producer.

The most extensive establishment engaged in the pottery business in California, and doubtless west of the Rocky Mountains, is that of Gladding, McBean & Co., whose factory is located at Lincoln, Placer County, on the line of the Oregon Division of the Central Pacific Railroad, with their principal office and depot in San Francisco. Starting in business in 1875, their works have, from time to time, been enlarged, and buildings of two hundred and twenty-five by four hundred feet, constructed of brick and iron, are now in use. Three large boilers and engines of one hundred and fifty horse power, of the latest and most approved patterns, furnish motive power. In addition there are six large clay mills, two steam presses, elevators, etc., and all details appertaining to a pottery factory plant of the most complete character. About one thousand five hundred feet of side tracking have also been constructed. At the outset, their attention was devoted exclusively to the manufacture of sewer pipe, but gradually branching out, as the necessities of the demand warranted, they now produce a great



variety of articles, chief among which may be mentioned terra cotta, for architectural and ornamental purposes, piping, fire roofing, tile, fire-brick, building brick, etc. Their unusually fine work in terra cotta, and the great variety of their designs, would seem to merit special attention, as nowhere in the United States are they surpassed. Among the specimens of terra cotta work turned out from this establishment for the Society of Pioneers' building, San Francisco, is a very artistically executed medallion of General John A. Sutter, who arrived in San Francisco (then Yerba Buena), in the month of June, 1839. Afterwards built the famous fort at Sacramento, and in 1848-49 made himself so serviceable to the overland immigration of that time.

General Sutter.

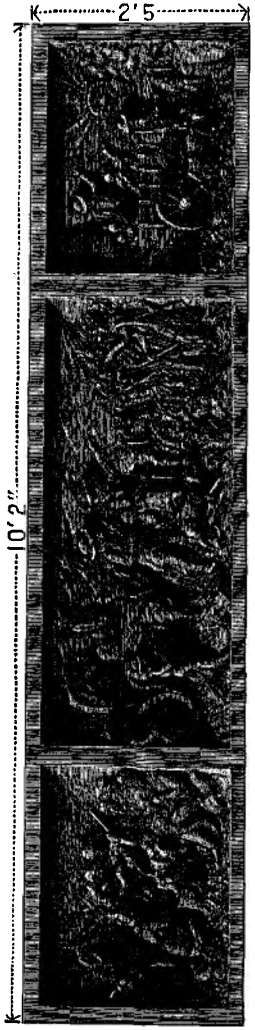
A very handsome sample of terra cotta ornamental work is in place at the State Mining Bureau, as are also samples of clays, which have been analyzed and are used in the manufacture of pottery wares and fire-bricks.

A very excellent panel, representing that immigration, and called "Pioneers crossing the plains," is in the same collection. The panel is in three partitions, and, as will be seen by the copy given on the following page, represents the hardships experienced by the immigrants en route, and the joy shown when the promised land first broke upon their view.

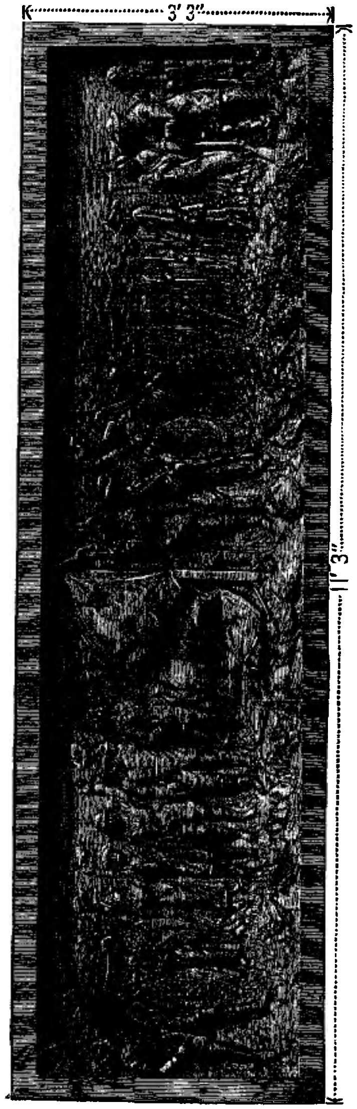
Some two hundred employés (white labor exclusively) find steady employment the year round at remunerative wages. The output of their manufactory finds its way in large quantities to every coast State, and as far south as Texas. The architectural terra cotta used in the new "Chronicle" building, also the fire-proof tiling, is of this firm's manufacture; so also are the terra cotta ornaments in the Pioneer Hall, New California Hotel and Theater, the cathedral on Van Ness Avenue and O'Farrell Street, W. H. Crocker's residence, California and Jones Streets, and very many other of the costliest structures in San Francisco, as well as the principal buildings of the leading cities and towns of the coast.

Another episode of the early history of California, perpetuated by the artistic terra cotta work of Gladding, McBean & Co.'s establishment, is the raising of the bear flag at Sonoma on June 14, 1846, when the country was declared independent by a small party of ambitious adventurers; the flag bore the words "California Republic."

Introduced for the first time on this coast by the above named firm, are what is known as the "Roman Brick," made of fire-clay and burned to a



Pioneers Crossing the Plains.



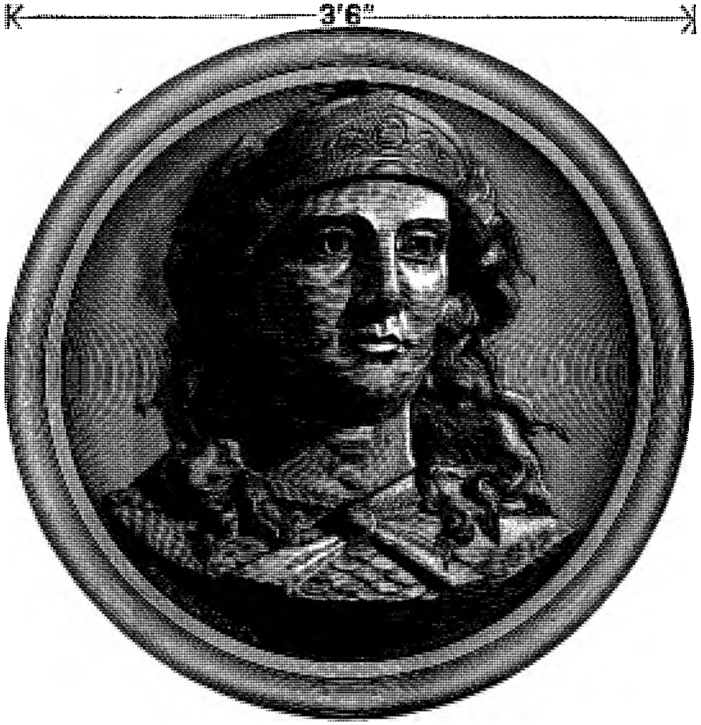
Raising the Bear Flag.

dark straw color. They are twelve inches long and four inches wide, an inch and a half thick, and are exceedingly strong as well as fire-proof. This variety of brick is largely used in the principal eastern cities, and its introduction to popular use here would seem to be but a question of time.

There are quite a number of potteries in various portions of the State, chief among which may be mentioned that of N. Clark & Sons, of Alameda County, with principal office and depot in San Francisco. They began business in Sacramento in 1864, but their plant being destroyed by fire, removed to Alameda County. They employ fifty hands, white men exclusively, and their works are kept running the year round. Sewer-pipe and fire-brick are the principal articles of manufacture. Their clay is shipped almost exclusively from Carbondale, Amador County.

Serril Winsor, with a well equipped factory at East Oakland, Alameda County, employs forty men during the greater part of the year, work being stopped some two or three months during the winter time, generally from about the middle of November to the first of February. Their clays are likewise obtained principally from Carbondale, Amador County, at an estimated cost of about $3 50 per ton laid down at the factory. The principal articles manufactured are sewer pipe, chimney and flue pipes, and flower-pots. The main depot and office are in San Francisco.

In addition to what may be called the terra cotta illustrations of California's early history—made in this State, and now in the Pioneers' collection—is the medallion of an ideal head of Liberty. The subject is treated with a great deal of freedom by the designer, and the face is splendid in the reposeful majesty of power. But it is also interesting to minds of a practical character to notice how well adapted is the material used to give sharp and perfect expression to the fine as well as broad lines of the design.



Liberty.

At Los Angeles the California Sewer Pipe Company is quite extensively engaged in the business its name indicates; at Riverside, the Pacific Clay Manufacturing Company; at Elsinore, the Southern Coal and Clay Company; at Sacramento, George Muddox; at San José, A. Steiger & Sons, and Tracy Bros. & Co., of San Francisco, are all engaged in the manufacture of various articles in clays for structural, ornamental, and other uses.

California contains within her borders deposits of those clays which, by proper washing, yield kaolin. Some of those which have been examined by the State Mining Bureau compare favorably with the foreign clays from which the noted porcelains are produced.

FOREIGN KAOLINS.

	China.	St. Yrieux.	Aue.	Cornwall.	Morl.
Silica	50.63	48.37	46.00	45.82	71.42
Alumina	32.74	34.95	39.00	38.60	26.07
Iron oxide	2.64	1.26	.25	----------	1.93
Lime	.50	----------	----------	3.47	.13
Magnesia	.27	----------	----------	----------	----------
Alkalies	2.52	2.40	----------	1.77	.45
Water	10.01	12.62	12.74	9.08	----------

AMERICAN KAOLINS.

	Indiana.	New Jersey.		Wisconsin.		
Silica	40.50	45.61	38.20	49.94	69.34	58.47
Alumina	36.35	39.04	35.09	36.80	19.19	28.87
Iron peroxide	.15	1.10	1.82	.72	1.75	1.54
Lime	----------	----------	----------	----------	.44	1.62
Magnesia	.13	----------	.21	----------	.31	.99
Alkalies	.14	2.51	2.65	.92	5.73	2.64
Water	22.60	10.90	12.10	11.62	2.67	9.48

Examinations were made of twenty clays which, to the eye alone, gave promise of merit, of which number fifteen were finally taken for analysis, eleven of which are of a character worthy of being reported upon, the others being worthless for pottery.

CALIFORNIA.

	1	2	3	4	5	6	7	8	9	10	11
Silica	85.07	88.70	59.98	57.02	57.75	47.33	49.08	48.90	12.54	66.75	88.30
Alumina	7.85	4.50	30.29	31.06	30.60	38.00	37.09	38.18	42.97	37.35	.85
Iron peroxide	1.16	.50	.27	.53	.48	1.08	1.91	2.40	.63	.25	.15
Lime	.25	.93	.28	------	.20	.67	.53	.50	------	.20	1.03
Magnesia	.35	.36	------	------	.10	.42	------	.09	------	------	.48
Alkalies	.93	.63	1.02	2.32	1.30	.71	------	1.85	4.70	4.32	5.07
Water	4.35	4.46	8.05	8.95	10.15	11.65	10.60	8.65	38.40	50.25	4.40

Clays one and two were separated from the coarse sands, that which was analyzed passed through a one hundred-mesh screen. Clays three to eleven were separated from all sandy impurities by washing.

Clay No. 1 is from near Jolon, Monterey County; it is white with a tinge of yellow; when moist has a yellowish-brown color, semi-plastic; suitable for the production of the finest grades of terra cotta.

No. 2 is a sandy clay from Chico, Butte County; white, with brownish tinge; when moist has a light-brown color; it also is suitable for terra cotta work.

No. 3 is a fine white clay from Amador County, very plastic; suitable to make finest grades of porcelain. This clay contains 73.63 per cent of pure kaolin; 24.37 per cent of the silica is partially in the hydrated state, and combined with the other bases.

No. 4 is from Carbondale, Amador County; it is white and plastic, could be used for porcelain; contains 76.2 per cent of pure kaolin; 20.83 of silica is in the hydrated state.

No. 5 is from near Grass Valley, Nevada County, on Section 3, Township 15 north, Range 9 east. It is a fine clay, suitable for fine ware, white and plastic; can be made highly so by working. It contains about the same percentage as No. 4.

No. 6 is also from Grass Valley, Nevada County, on Sections 4 and 5, Township 16 north, Range 8 east. This is a fine white clay, suitable for any purpose, being plastic and soft; it contains 94 per cent of pure kaolin; 3 per cent of silica is combined with the bases.

No. 7 is a fire-clay from the Clipper Coal Mine, near Lincoln, Placer County; it is nearly a pure kaolin, soft and unctuous; would hold a large percentage of siliceous material.

No. 8, a fire-clay from Carbondale, Amador County; this is also nearly a pure kaolin; the original sample held 70 per cent of coarse siliceous material.

No. 9, a clay from near Daggett, San Bernardino County; it is soft, white, and very plastic, contains a large percentage of alumina. The chemical composition of a pure kaolin is $Al_2O_3 2SiO_2+2H_2O$, but that of the above gives the following: $2Al_2O_3SiO_2+10H_2O$. Theory would show that it is pure kaolin combined with aluminum hydroxide, and would be represented by the fomula: $(Ai_2O_3 2SiO_2 2H_2O)+3(Al_2O_3 6H_2O)$.

In producing porcelain from this clay, a large per cent of silica would be required, also additions of lime. In experiments conducted at San Diego porcelain of good character was made from clay beds found near Daggett.

No. 10 is an aluminous clayey body from the sulphur banks in Lake County. It is soluble in sulphuric acid, the silica readily separating out; it could be cheaply manufactured into alum. This clay is well adapted, judged from our original sample, for use in sizing paper.

No. 11 is from Carville, Trinity County; is not strictly a clay, though white, soft, and somewhat plastic; under intense ignition it slightly agglutinates, and after cooling feels sandy; it resembles more nearly in character the Japanese clays exhibited in the International Exhibition of 1876.

In conversation with parties who apply to the Mining Bureau for information in regard to kaolin we find that they have, as a general rule, an idea that kaolin to be valuable must be found in a state of comparative purity. This is an error that we deem of sufficient importance to correct in this report.

The clay from the most noted deposits in Delaware County, Pennsylvania, is not, as taken from the pit, fit for the potters' use, and it is necessary to separate the pure clay from deleterious ingredients. The amount of contamination usually found may be inferred from the statement of H. A. Johns, of the National Kaolin pit: that to produce twenty thousand tons of washed clay about sixty thousand tons of crude clay have been removed from the pit, and that there has probably been handled five hundred thousand tons of material, including the crude clay. A brief description of the method employed may serve as a guide in future works of the kind in this State.

The crude clay is separated, by careful digging and handling, from a large mass of sand with which it may be associated; it is then hauled to the mill and placed on the stock pile, from whence it is taken and dumped into the mixing trough, in which the clay is thoroughly broken up and mixed with water.

The clay and sand mixed with water runs into a trough, in which a vertical wheel revolves with pocket elevators on its circumference. The sand in this trough settles to the bottom, and is carried off by the pocket elevators.

The water holding the clay in suspension then passes into board sluices known as "clay runs" or "slips." These slips are placed side by side, and the clay in going through them is carried over a distance of between six hundred and nine hundred feet. As the clay passes through these sluices the sand falls to the bottom, and is ultimately removed from the troughs.

The final discharge is into large settling vats, where the pure clay, in the course of a day or two, settles; the clear water is then drawn off from the tops. From these vats the clay is pumped, under pressure of about one hundred and sixty pounds, into canvas bags, and placed in hydraulic presses, where the excess of water is removed. The clay, after removal from the press, is placed on shelves in the open air to dry. In this state it is sold to the manufacturers of fine chinaware and porcelain.

The final methods of preparing clays and other ingredients requisite in the production of porcelain differ in each country and in different works. Nationalities have methods peculiarly their own, and each manufacturer endeavors to retain as his own the secrets of his particular compositions and methods of combination.

The following can be assumed to be the general method followed throughout the various countries:

Clays brought from the beds are allowed to "slack" in the air and disintegrate; different clays requiring more or less time, according to the nature of their constituents and the season of the year; after the aging has occurred the clays are washed.

The clays are "dissolved" in water; that is, pure clays, being of light gravity, suspend readily, while "undissolved" clays, sands, and coarser particles sink in the water.

The impure clays are placed in circular tanks or vats, four by six feet in diameter, in the center of which is a revolving perpendicular shaft with arms radiating and so arranged as to thoroughly cut up and incorporate the clay and water; when the mixture is equally and thoroughly combined and has attained the thickness of cream, the floating clay is drawn from the mixing vat into the sifting apparatus, which are inclined screens agitated by cams, the first two of the series being of a coarse and fine wire, the other of silk bolting cloth, arranged so that the clay which passes through the wires is carried to the higher end of the silk cloth.

The clay which has passed through the silk bolting cloth runs into the bottom of a second circular vat, which has revolving arms that rotate slowly; the overflow from this tank is run through long "launders" or sluices to the settling tanks; the clay, after passing through the silk screens, still contains a small percentage of minute sands and micas, which separate by their own gravity in the "launders."

From the "launders" the purified clay is run into circular vats, allowed to settle, the clear water run off (if necessary, it is here treated with acid, then washed to remove acid and salts by agitation with water, settling, and decantation); the clay is then made up with water to a known consistency; that is, each gallon of water should hold a certain weight of solids in an agitated solution.

The treatment of the silica is as follows: To render the material more easy of pulverization it is heated red hot and thrown into water; this causes the mineral to decrepitate. It is then ground and washed much in the same manner as the clays, being run into vats and made up into a known consistency.

The feldspars and limestones are also ground until they are reduced to such an extreme state of subdivision that the particles remain suspended in the water.

The different materials having been brought to known consistencies, the combination of ingredients is made by allowing the required quantity of each fluid to flow into a common tank, where it is thoroughly agitated and pumped to a higher vat, from which it is carried to the drying floors, pans, or presses. After the excess of water is expelled and it has attained the consistency of putty, it is beaten and made into balls and stored away in rooms to ripen, which takes more or less time, according to the nature of the clays.

Where clays have been thoroughly washed at the banks, or when the coarser kinds of chinaware are to be produced, the process of conveying the raw materials through "launders" is sometimes omitted.

Investigations and analyses of the Japanese porcelain and crude clays (exhibited at the Centennial Exposition at Philadelphia) from which their finer grades of porcelain ware are manufactured, created considerable surprise to chemists who had hitherto taken it for granted that kaolin was the basis from which their porcelain was made. By reference to the subjoined analyses, made by Henry Wurtz, it will be readily seen that only one of the eight samples of Japanese clays (F) bears a resemblance in any chemical composition to kaolin. This was an astonishing revelation to those familiar with the manufacture and composition of porcelain.

—	Tsuji-Chuchi	Shiro-Chuchi	Sakaime-Chuchi	Uwa-Kuszuri-Chuchi	Indo-Chuchi	Kudaru-yama-Chuchi	Sei-ji-Chuchi	Shira-Kawa-Chuchi	Eggshell Porcelain	Thick-body Porcelain
	A.	B.	C.	D.	E.	F.	G.	H.		
Silica	78.181	77.685	78.073	78.210	82.292	49.931	77.844	79.130	78.763	75.545
Alumina	15.699	15.189	13.993	14.407	11.981	38.738	13.510	16.440	17.847	19.315
Ferrous oxide	.663	.895	1.020	1.408	.130	1.582	1.530	1.289	.638	1.916
Lime	------	.146	.186	.097	.287	------	------	------	.213	.106
Magnesia	.099	.096	.229	------	.064	.206	.307	.240	.029	.176
Soda	1.744	1.469	1.722	1.385	2.981	1.445	3.993	1.490	1.975	2.832
Potash	.551	.508	.961	.142	.506	.440			.203	.566
Manganese oxide	trace.	.013	.031	------	.072	------	------	.150	------	------
Combined water	2.518	3.330	3.320	3.715	1.155	7.607	1.297	.910	------	------
Totals	99.430	99.331	99.545	99.464	99.477	99.949	98.481	99.640	99.668	99.456

A. The Tsuji-chuchi.

This is the most valuable and costly variety of the porcelain stone found at Idzumi-yama, and forms 70 per cent of the body of the finer eggshell porcelain. It is a dull white, porous, granular, coherent mass, not very unlike coarse chalk in appearance, but somewhat harder and very much tougher; breaks with difficulty; is rough to the touch, smearing the fingers, though not readily; fracture granular, conchoidal, dull; mass obscurely laminated(?). It adheres to the tongue, with a chalky taste, and has a distinct odor; much more of a chalky than a clayey character. It crushes grittily between the teeth, not at all with a sandy or quartzose grit, but about like calcite. In the mass, under a low magnifying power, it has almost a saccharoid appearance, composed apparently of small granules, which have a distinct though dull luster.

B. *The Shiro-chuchi.*

This variety is also used in the eggshell ware to the extent of 30 per cent of the washed mineral. In the mass it is finer grained, harder, tougher, and more compact than A, but otherwise quite similar, having an equally white color and a like chalky taste and odor, adhering to the tongue, and smearing the fingers slightly (when hard rubbed), though without the slightest smooth or unctuous feel. Diffused throughout it are some small, dark colored specks not present in A; these, under the magnifier, are seen to contain slight nuclear remains of small crystals of iron pyrites. On blowpipe test these specks gave an iron reaction, but no permanent color was imparted to a phosphorus-salt bead in either the oxidizing or reducing flames. The proportion of finer material obtained by the same process of crushing and elutriation was much smaller than in the case of the Tsuji-chuchi, being but 25 per cent; but, except in the presence of a little lime and a little more iron, the composition of this washed portion does not greatly differ from that of A. The Shiro (like the Tsuji-chuchi), though dull to the eye, shows, under the magnifier, on the part of the granules which make up the mass, a distinct degree of luster, scarcely less than that of the fracture of the porcelain itself.

C. *The Sakaime-chuchi.*

This variety is used, with the Shiro-chuchi, in compounding the body of the thicker and commoner porcelain. There is little in its appearance to distinguish it, either by the eye or the magnifier, from the Shiro-chuchi, except possibly less hardness and a little coarser grain.

D. *The Uwa-kuszuri-chuchi.*

This variety is used in compounding glazes, in admixture with lixiviated wood ashes. It differs from the preceding varieties in being softer, smearing the fingers readily (without any clay-like smoothness, however), and it has throughout a good many dark specks, accompanied by points of iron pyrites visible under the lens. In other respects, its general description resembles the preceding companion minerals. After ignition and grinding, the powder was pale pinkish. Elutriation yielded 35 per cent of the mass.

E. *The Indo-chuchi.*

A great interest attaches to this variety from the fact, as stated by Dr. Wagener in his letters, that it still retains, in admixture, some of the unaltered mineral, from which he conceives all the four preceding kinds, together with the one which comes next (F), to have been derived by unknown processes of alteration. It presents a coarse-grained mass, rather regular in texture, color, fracture, and degree of porosity. In some places it is quite white, in others much stained with limonite. Scraping with a knife at once distinguishes some harder parts, or flakes, dispersed irregularly throughout the mass. With great labor a considerable quantity of this harder material was dissected out, and crushed to a coarse powder, in order to remove the remainder of the soft portions adherent, which was accomplished by grinding in a mortar with water, with a light pressure, so long as the water became at all milky. A coarse, sand-like material was thus obtained having fully the hardness of unaltered feldspar.

Under the magnifier this presented the appearance of angular, opaque, milk-white fragments, conchoidal, and dull. No traces of feldspathic cleavages. Some grains show what appeared like encrusted, or possibly corroded surfaces, a little honeycombed and lustrous, which may indicate alteration. On ignition of these grains, they first blacken somewhat, apparently from presence of organic matter, but quickly burn white again. This behavior is very curious, differing from that of any of the associated minerals. No very marked odor accompanies this blackening, but the water given off has a distinct acid reaction, due very likely to sulphurous acid; so that the blackening may be due to the coexistence of a trace of sulphuric acid, or an acid sulphate with organic matter. Another curious fact about this Indo-chuchi was the development of a distinct musk-like odor from it when warm. After ignition most of the grains had assumed a reddish ferruginous tinge, some few, however, remaining white. The total iron in the mass, nevertheless, as shown by the analysis, is surprisingly small being evidently also in ferrous form.

F. *The Kudaru-yama-chuchi.*

This is the variety also called Kesso-chuchi. It is, like the last, of especial interest, for several reasons, one of which is that this is the only variety presenting any approach, even in aspect, to a clay. It is a pure white, chalk-like substance, easily rubbed up between the fingers, with a slight unctuous feel, but quite inferior in this latter respect to a true clay. Under the magnifier it appears to be made up of very small, amorphous, transparent grains, irregular in size. In water it immediately falls to powder with effervescence (from escape of air), but the paste formed has very little of the plasticity of that formed by true clays.

It is chalk-like in odor, like the other minerals of the group, and shows no grittiness between the teeth. Even after ignition, and notwithstanding its very appreciable proportion of iron, its color remains pure white. Like all other related minerals, it may, when in powder, be fritted fast to a fine platinum wire by the intensest heat of the mouth blowpipe, though possibly with more difficulty than the others.

G. *The Sei-ji-chuchi.*

This one, as stated by Dr. Wagener, is not a companion material of the preceding six, not coming from the Idzumi-yama quarries, but from some other place in the neighboring country. The analysis was not, therefore, made by the absolute method. Like D, it is used as a glaze constituent for a peculiar green glaze. Its grain is much coarser and rougher than that of the preceding minerals, and it is very distinctly laminated in structure.

H. *The Shira-kawa-chuchi.*

This mineral—also, like the last, not from Idzumi-yama—is used in admixture with B and C in making the peculiar glaze for the crackle ware. It is white, with brownish bands and stains, finer grained than G, but coarser than the Idzumi-yama group, porous, rough to the touch, but smearing slightly, adhering to the tongue, with a chalky odor and taste, and had a feeble flesh-color in powder after ignition.

J and K.

Examination of the figures in the analyses of the eggshell and thick-body porcelains, and comparison of them with the analyses of the washed minerals, shows that while the correspondence in the case of the eggshell body is quite close enough to verify the formula given by the makers, in the case of the common porcelain there is quite a marked and decided departure from the composition that should follow from the specified mixture of components. Whether this discrepancy is due to variations in the composition of the Shira and Sakaime-chuchi (variations by no means improbable), or to some other cause, it seems almost useless, under existing circumstances, to conjecture. The deficiency of silica and excess of alumina, in the thick-body ware, over the minerals stated to enter into it, appears too large to be accounted for by the mere coating of Kudaru-yama-chuchi, which is given before glazing; but this may, nevertheless, have had some influence. We must rest satisfied with the important verification presented by the analysis of the finer eggshell ware, of the surprising fact that Japan porcelain, excelling all others in important characteristics regarded as normal for porcelain, par excellence, is made without the use of kaolin at all, or of any equivalent therefor; being compounded, as to its body, solely of the petuntse-like or petrosiliceous minerals. Indeed, the traditional principle, so often repeated in the literature of the art as a proverb of the Chinese, that while "the petuntse constitutes the flesh of porcelain, kaolin must form its bones," is proved here to be altogether inapplicable. It may also be submitted that a common popular belief regarding Oriental porcelain in general—which appears to have been altogether accepted since the celebrated memoir of Ebelmen and Salvétat was published, about 1850—that no essential technological differences exist between European and Oriental porcelain fabrication, should no longer be so implicitly accepted.

Among the clays from California analyzed in the State Mining Bureau, Number 11, from Carville, Trinity County, upon analysis was found not to be a true clay, being almost totally deficient in alumina. The crude material absorbs water readily, is perfectly white, and forms a somewhat plastic mass. It is probable that this material will form a desirable ingredient in the manufacture of porcelain. Experiments made upon the washed clay prove that, without any admixture whatever, the objects molded, whether in the form of thin sheets or in larger masses, retain their shape and become compact after subjection to the flame of the gas blowpipe, and that the thinnest sheets become vitrified and translucent.

CALIFORNIA CEMENT.

Since the last report of the State Mineralogist was issued, and which contained, among many other papers, an exhaustive article on natural and artificial cements, there have been discovered in different parts of the State several deposits of limestone necessary to the manufacture of this useful building material, and some of considerable importance by reason of superior quality.

One of these recent finds, in San Diego County, consists of fine concretionary limestone, so soft that it resembles precipitated carbonate of lime.

Samples from one of these many "soft lime" deposits give, by analysis, the following results:

Silica	1.86
Alumina	1.10
Carbonate of lime	94.28
Carbonate of magnesia	1.19
Carbonates of alkalies	1.15
	99.58

From the above class of limestone cement has been made at the crude works in San Diego, and the product, laid as sidewalks, proves entirely satisfactory. An analysis of this cement gave:

Lime	65.20
Magnesia	1.20
Silica	24.00
Alumina	5.24
Iron peroxide	2.21
Alkalies	1.00
Sulphuric acid	.20
Carbonic acid	1.00
	100.05

This cement corresponds very closely in composition to an English cement, the trade mark of which is K. B. & S. Until within the last six months, no Portland cement has been produced on the Pacific Coast. The Natural Cement Works at Benicia and Santa Cruz have lain idle for some time. It will be interesting, therefore, to reproduce the main facts in connection with this new enterprise, as given by a San Diego local paper:

The company reorganized to carry on this industry is called the Jamul Portland Cement Company, with Warren Wilson, President, W. P. Adams, Vice-President, and Benjamin McReady, Secretary. The plant is designed to produce two hundred barrels of cement a day—a regular working day of ten hours. The total annual product will reach between fifty thousand and sixty thousand barrels; but it will only supply a small portion of the cement required for California alone, which, last year, consumed between three hundred thousand and four hundred thousand barrels.

According to the San Francisco "Journal of Commerce," the amount of cement imported into this State during the year 1889 was two hundred and fifty-one thousand three hundred and ninety-nine barrels, costing, in Europe, $250,148. The falling off in the importation from the previous year is due to the fact that the market was overstocked by a speculative movement. If the Jamul enterprise is a success, the works will be enlarged, the capacity trebled and quadrupled, and one of the city motor roads extended to the ranch where the limestone deposit exists. The plant will be erected in the Jamul Valley, as about sixty tons of the raw material will be consumed daily. A large warehouse will, however, be erected in San Diego.

The reorganized company starts, it is stated, with an ample cash capital, as well as with a definite purpose. Professor Leonhart, an employé, has gone to England and Germany, where he will spend two or three months studying the latest methods of manufacturing Portland cement. His knowledge, combined with the Professor's previous practical experience in the business, will be used in constructing the two kilns, the most important, perhaps, and the most delicate part of the whole enterprise.

President Wilson accompanied the Professor as far as Pennsylvania, where there are Portland cement works now in operation. Prices of machinery and estimates of costs of manufacture will here be obtained, in addition to that already in the possession of the company, and the preliminary work will have been accomplished upon Professor Leonhart's return. It is calculated that about the middle of April, 1890, the Jamul Cement Works will be turning out an excellent quality of material.

OTHER DEPOSITS.

On the mesa, or flat land, at the edge of the foothills, near Mission San Fernando, Los Angeles County, a shell limestone, much worn, is found, the cavities of which are filled with sand. An analysis shows it to be composed of the following constituents:

Sand	12.24
Insoluble silica	7.48
Soluble silica	.74
Alumina and peroxide of iron:	
Insoluble	1.62
Soluble	1.65
Carbonate of lime	72.68
Carbonate of magnesia	1.05
Chloride of sodium	.67
Water	1.76
Sulphuric acid	Trace.
	99.89

This limestone will make a Portland cement, if burned and afterward manipulated according to the English and French methods, of which a very full description is given in the article previously referred to.

At a point a little northwest of the town of Santa Barbara, a limestone has been discovered with the necessary composition for a good cement.

Near South Riverside, San Bernardino County, a dark limestone occurs, from which a good natural cement could be produced. The cement made from it would, however, carry the color of the stone, would set quickly, and not stand a great tensile or crushing strain.

A bed of marl, exposed near the City of Santa Cruz, would also make a good natural cement.

The last deposit that has come to notice is in the neighborhood of Port Costa. This is a crystalline limestone, soft and easily crushed, from which a good article of cement, as well as lime, could be made.

Its analysis shows:

Carbonate of lime	97.85
Carbonate of magnesia	.63
Chloride of sodium	.14
Silica	.26
Iron and alumina	.20
Water and carbonaceous matter	.50
	99.58

METEOROLOGICAL.

By Geo. E. Barnes.

The popular theory that cultivation of the soil, irrigation, the influx of population, and the construction of railroads, has a controlling effect upon the climate of a country, is subject to many modifications when applied to California. In fact it is doubtful whether these things have anything more than a moderative influence upon the meteorology of the Golden State. As a matter of fact the great storms which largely affect the weather and climate of California and Oregon have their birth, not among the foothills of the high Sierras, nor along the bold headlands of the coast, but are conceived, brought into being, and gather strength in the broad wastes of the north Pacific Ocean. Thence, driven by the irrefragable laws of nature, they seek the land. The great Japan current acts as a meteoric chariot for the Storm King, and wafts him shoreward. He is landed upon the southern coast of the Strait of Juan de Fuca. At Cape Flattery, the extreme northwest point of the United States, may be said to have been established by nature a mighty signal station. Cape Flattery is not only a storm center but it is the great rain center of the Pacific Coast. When Jupiter Pluvius touches its rock-bound limits his minions scatter in all directions, but those which travel to the south and east are more lightly burdened than their fellows that hasten toward the north. As the misty messengers are wafted inland they discharge their aqueous cargoes. Washington and Oregon get the largest share; then southward they drift into California, to that section back from Cape Mendocino to where the Sierra Nevada and the Coast Range unite in the grand mountain mass of Shasta. Here is the region of greatest rainfall in the State, the rain gauge showing from thirty to sixty-five inches of annual precipitation, while in some of the valleys surrounding the snow-clad peak, as much as one hundred and eight inches have accumulated in one season. The rainy season is, however, comparatively short, many inches being registered at a single downpour, with only an occasional thunder storm between June and October. In the high Sierras these occasional summer rains extend further southward, and the dwellers in the fertile valleys and along the productive foothills are often startled by the gathering of dark cloud-caps far above them and the crashing of the thunderbolt as the surcharged mass is broken against the mountain peaks, while directly overhead the sky is still blue, the air is soft and dry, and the face of the sun itself is not obscured. Following the trend of the great mountain range the rainfall averages twenty inches as far south as the headwaters of the Kings and Kern Rivers. From that point the precipitation lessens until the arid plain of the Mojave Desert is reached, where it does not exceed four inches per season. To better exemplify this course of the rainfall a record of the rain-gauge along the way is given: At Humboldt, on the coast, the mean annual precipitation is 34.75 inches; at Weaverville, Trinity County, it is 43.31; at Reed's Camp, Shasta County, 72.09 (during the season of 1880–81 it amounted to 95.46 inches); Mumford Hill, Plumas County, 69.27; Grass Valley, Nevada County, 48.79; Buchanan, Fresno County, near the headwaters of Kings River, 18.78; and at Daggett, San Bernardino County, on the Mojave Desert, 3.98 inches. A similar peculiarity in the distribution of rainfall may be observed by following the record of the rain-gauge down the coast. The yearly mean precipitation at the several specified localities is as follows: Point Arena, Mendocino County, 30.49 inches; Petaluma, Sonoma County, 22.85; Point Bonita, Marin County, 25.43; San Francisco, 25.22; San Mateo, San Mateo County, 18.43; Santa Cruz, Santa Cruz County, 25.60; Monterey, Monterey County, 15.14; Pajaro, Monterey County, 18.12; San Luis Obispo, San Luis Obispo County, 20.75. Here Point Concepcion is reached, and southward the climate moderates and there is noticed a slight decrease in the precipitation. At Santa Barbara it is 17.29; at San Buenaventura, 16.87; Los Angeles, 16.03, and at San Diego, 10.26 inches.

It will be of interest to trace, in connection with the foregoing, the record of precipitation along the great valleys of the Sacramento and San Joaquin. Beginning near the headwaters of the former, at Red Bluff, Tehama County, the mean annual rainfall is found to be 24.55 inches; at Chico, Butte County, it is 20.32; Colusa, Colusa County, 16.85; Marysville, Yuba County, 16.22; Woodland, Yolo County, 17.59, and Sacramento City, 19.05 inches. Turning to the San Joaquin the rainfall is found to be lighter near its source, and to increase gradually as it makes its way down the valley. At Sumner, Kern County, the annual precipitation is but 5.38 inches; at Tulare City it is 6.62; at Fresno, 8.79; at Merced, 11.75; at Hills Ferry, Stanislaus County, 11.70; and at Stockton, where the San Joaquin joins the Sacramento, it is 13.91 inches. This valley, next to the Mojave plains, is the most arid section of the State. It is here that some very extensive schemes of irrigation have been inaugurated. What effect these may have upon the rainfall of the future is an unsolved problem.

THE RAINFALL.

The following table shows the average rainfall for each month in the year, together with the yearly average, and the greatest amount that has ever been precipitated during any season, as also the least amount at sixty-six places in California. The average mean is calculated from data gathered from records extending back from five to forty years, and has been carefully rearranged and prepared expressly for this report:

Note.—In places where there is a snowfall the snow has been reduced to rain, allowing ten inches of snow to one of rain.

NAME OF STATION.	January	February	March	April	May	June	July	August	September	October	November	December	Yearly Average	Greatest Seasonal Precipitation	Least Seasonal Precipitation
Almaden	1.52	8.60	.92	.00	.00	.00	.00	.20	.05	.60	.80	14.29	--------	--------	--------
Alta	8.56	7.26	6.92	3.67	1.38	.51	T.	.00	.34	2.17	4.81	6.52	42.14	69.70	17.24
Arcata	5.85	6.07	3.08	7.38	1.32	.00	.00	.00	.00	3.19	1.17	9.03	37.69	--------	--------
Auburn	6.13	5.23	4.49	3.76	1.18	.36	.02	.01	.34	1.42	3.49	5.94	32.37	44.87	17.50
Blue Lake	12.66	7.34	3.98	8.14	2.08	1.04	.47	T.	2.08	1.91	16.68	20.08	76.46	--------	--------
Boca	4.26	3.43	2.68	1.51	.40	.13	.24	T.	.02	.57	.91	2.72	16.87	23.40	8.05
Bowman's Dam	14.00	11.07	10.77	7.78	2.59	.83	.20	.02	.71	3.65	7.94	14.00	73.56	102.22	14.37
Buchanan	2.60	3.12	3.00	4.33	.09	.14	.00	.00	.89	.46	.81	3.39	18.77	22.77	8.70
Byron	2.11	1.59	1.84	1.86	.32	.22	.00	.00	T.	.49	1.31	2.28	12.02	18.25	7.34
Cisco	10.83	10.74	8.79	5.22	2.36	.79	.11	.00	.28	2.17	4.56	9.25	55.10	80.46	34.00
Camp Far West	6.92	1.26	12.70	4.46	.86	.00	.00	.00	2.30	.10	3.96	8.64	41.20	--------	--------
Cherokee	8.37	7.55	7.95	3.37	1.49	.60	.11	.06	.51	2.95	5.40	6.59	44.93	63.26	28.35
Chico	3.92	3.57	2.28	1.73	.71	.34	.03	.03	.27	1.02	2.39	3.77	20.06	34.72	12.91
Calistoga	6.83	5.20	4.29	3.11	.79	.31	.00	.00	.23	1.78	3.06	4.89	30.49	50.20	7.33
Colfax	8.36	6.77	6.28	4.97	1.63	.52	.00	.00	.32	1.74	5.06	7.67	43.33	60.06	27.61
Colusa	3.67	2.82	1.86	1.54	.49	.37	.04	.02	.19	1.04	1.82	3.17	16.99	32.84	9.20
Crescent City	13.69	10.44	6.29	8.58	2.75	2.31	.65	.08	3.49	10.22	11.37	18.90	88.77	135.43	69.72
Daggett	.48	1.44	1.25	.15	1.09	.05	.00	.00	.03	.00	.00	2.40	6.45	--------	--------
Delta	6.65	3.56	7.03	8.66	4.55	2.03	.05	.00	.02	4.54	6.70	9.21	53.00	75.24	33.30
Emigrant Gap	10.18	9.50	8.77	5.65	2.47	.74	.02	.01	.32	2.45	3.25	8.13	51.49	85.17	18.64
Firebaugh Ferry	1.78	1.14	1.12	.94	.16	.17	T.	T.	.07	.31	1.51	1.28	8.48	18.84	2.24
Fort Gaston	10.56	7.99	7.50	4.70	1.74	.75	.12	.11	.89	2.67	7.69	10.70	55.42	125.36	31.72
Fort Jones	2.88	4.10	2.77	1.25	1.21	.69	.06	.07	.20	1.39	2.59	4.39	21.60	32.03	18.89
Fresno	1.30	1.21	1.21	1.64	.30	.13	.00	.00	.12	.39	1.21	1.28	8.79	16.62	4.87
Georgetown	11.09	8.52	8.78	7.20	2.30	.82	.06	T.	.46	3.47	6.18	9.94	58.82	81.24	40.48
Gilroy	5.07	2.95	2.76	2.05	.40	.13	T.	.01	.20	.86	2.05	3.02	19.50	31.04	6.53
Grass Valley	10.03	7.10	7.57	5.61	1.90	.62	.05	.01	.69	2.81	6.06	8.17	50.62	65.32	30.23
Hanford	1.71	1.62	1.81	1.72	.27	.24	.00	.01	.04	.45	1.62	2.10	11.59	--------	--------
Healdsburg	5.52	9.31	2.28	.95	.39	.08	.00	.02	.24	.11	1.81	15.22	35.93	--------	--------
Hollister	2.42	1.83	1.67	1.25	.33	.19	.02	T.	.09	.55	1.32	1.49	11.16	18.12	4.69
Ione	2.88	3.28	3.06	3.39	.81	.30	.00	.00	.18	.91	1.67	2.86	19.34	29.73	13.04
Jackson	5.18	4.69	4.88	5.17	1.34	.32	.00	.00	.42	1.66	3.04	4.86	31.46	37.90	21.20
Los Angeles	3.93	3.76	1.90	1.34	.35	.09	T.	.08	.01	.39	1.49	2.73	16.03	32.16	3.97
Los Gatos	6.41	5.60	1.68	3.59	.15	T.	.02	.00	.03	.49	6.99	4.00	28.96	--------	--------
Marysville	3.28	2.46	1.84	1.63	.59	.25	.01	.01	.19	.89	1.74	3.33	16.22	26.86	6.65
Merced	2.65	1.41	1.44	1.78	.54	.19	.01	.00	.10	.43	1.24	1.96	11.75	30.83	3.03
Mendocino	9.90	8.90	7.36	4.77	1.31	.39	.08	.05	.45	2.60	5.51	7.96	49.28	80.97	29.19
Modesto	1.72	1.21	1.19	1.14	.33	.11	.01	.00	.09	.40	1.06	1.54	8.80	13.54	2.25
Mojave	.59	1.33	.40	.25	.01	T.	.06	.00	.03	.10	.37	.91	4.05	9.96	.00
Monterey	2.13	2.18	3.03	1.81	.41	.22	.04	.01	.86	.57	1.44	2.52	14.42	21.45	9.16
Nevada City	10.93	7.68	8.57	5.14	2.06	.60	.04	.03	.54	1.82	6.67	12.09	56.27	115.26	17.28
North Bloomfield	9.37	7.81	7.58	5.73	2.04	.64	.12	.02	.60	2.90	5.84	9.83	52.48	74.52	27.87
Oroville	3.49	3.11	1.25	2.42	.29	.10	T.	T.	.57	.80	3.34	9.46	24.83	31.21	18.46
Point Reyes	4.29	3.24	3.94	4.06	.76	.20	.00	.00	.30	1.37	3.81	6.12	28.09	--------	--------
Redding	7.07	4.98	3.91	3.66	1.45	.45	.05	.06	.37	1.89	3.62	6.74	34.25	59.92	8.78
Red Bluff	5.97	3.87	2.54	2.18	.78	.37	T.	.05	.41	1.22	2.84	3.76	23.99	61.65	13.52
Rocklin	3.95	2.97	2.56	2.10	.65	.25	.02	.01	.10	.80	1.74	3.59	18.71	26.06	10.26
Sacramento	3.71	2.77	2.95	1.90	.67	.12	.03	T.	.12	.66	2.12	4.53	19.41	36.36	4.71
San Bernardino	3.66	3.05	1.97	1.75	.44	.06	.02	.08	.05	.43	1.58	3.10	16.17	37.51	8.98
San Buenaventura	3.86	3.57	2.37	1.48	.38	.27	.00	.00	.01	.44	1.96	2.53	16.87	--------	--------
Santa Barbara	3.87	3.88	1.90	1.61	.33	.12	.00	T.	.04	.46	1.49	3.59	17.29	34.47	4.19
Santa Cruz	6.18	3.98	3.18	3.03	.51	.34	.01	.01	.32	1.36	3.53	3.79	25.24	36.41	16.48
San Luis Obispo	4.68	3.75	2.81	2.05	.35	.14	T.	T.	.03	.72	1.95	4.53	21.01	42.40	8.15
San José	2.70	2.49	2.47	1.97	.41	.20	T.	.00	.10	.53	1.16	1.78	13.18	21.17	4.99
San Diego	1.55	2.22	1.38	.90	.44	.07	.01	.19	.03	.29	1.02	2.16	10.26	25.97	3.71
Smartsville	7.11	5.70	4.48	3.16	.88	.44	.05	.00	.11	1.50	3.74	5.01	32.18	46.78	17.99
Sonoma	4.88	6.02	1.15	3.54	.29	.00	T.	.00	T.	.95	6.83	3.41	27.08	--------	--------
Stockton	2.67	2.46	2.14	1.65	.55	.15	.01	.00	.05	.50	1.11	2.62	13.91	22.04	6.87
Summit	8.39	8.96	6.78	5.77	1.68	.62	.08	.01	.19	2.34	2.82	7.32	44.96	87.99	23.34
Sutter Creek	6.56	4.91	4.90	4.78	1.33	.44	.03	.02	.26	1.80	3.88	4.28	33.19	--------	--------
San Francisco	5.06	3.76	3.07	2.04	.62	.15	.02	.02	.16	.85	2.85	5.20	23.80	49.27	7.40
Tehama	2.70	2.37	1.64	1.37	.54	.24	.05	.06	.18	.74	1.91	2.12	13.92	29.82	5.16
Tulare	1.29	1.23	.93	1.18	.31	.10	.01	.00	.02	.16	.44	.97	6.64	11.65	3.07
Ukiah	6.88	4.78	4.57	3.52	.98	.12	.00	.01	.48	1.43	3.94	6.21	32.92	54.88	19.88
Watsonville	4.85	4.74	2.14	1.76	.59	.00	.00	.00	.10	1.17	1.75	7.43	24.53	--------	--------
Yreka	3.19	1.75	1.55	1.04	.83	.39	.26	.08	.37	1.46	1.77	2.52	15.21	22.48	10.53

THE FOGS.

An important factor in considering the meteorology of California, particularly of the coast counties, is the fogs. Although not generally included in considerations of rainfall measurements, they produce effects nearly related to rainfall. The temperature of the Japan current is almost uniform throughout the year. As the land becomes heated above or cooled below this temperature, the contrast resulting in close proximity creates these fogs. In summer, so wide is the difference that the comparatively cool ocean is lined with a wall of thick fog vapor that rises one thousand feet or more, rolling in upon the mountains, and, where a gap occurs, forms a river of fog, as Lieutenant Glassford terms it, submerging everything in its path; broadening and branching out, it follows up the valleys until dissolved by the dry air of the interior. These fogs add considerable moisture, and not infrequently five hundredths of an inch of water will be precipitated in a single night.

The rainfall tables show that in ascending the west side of the Sierras the precipitation increases at the rate of about one inch for each one hundred feet of elevation. In descending the eastern slope, however, it decreases more rapidly. In the mountain towns of Nevada, Placer, El Dorado, and Amador Counties the midday temperature during the summer months does not vary much from that of places in the Sacramento Valley, but the nights are cooler, and the winter climate is cold. In places, at an elevation of three thousand feet, ice forms five or six inches thick, and there is generally snow enough for sleighing. At points six thousand feet above the sea level snow five or six feet in depth covers the ground for four or five months in the year. The temperature falls regularly as we ascend the Sierras, and continues to decline after we begin to descend on the eastern side, the January climate of Truckee being several degrees colder than that of Cisco, which is at a higher elevation on the western slope. The heat of midsummer increases until an altitude of three thousand feet is reached, and then begins to decline. In this connection the following table, giving the result of meteorological observations at several mountain and mining towns, will be of interest. It shows the elevation, average mean temperature for each division of the year, the highest and lowest temperature, and the annual average rainfall:

NAME OF STATION.	Elevation—Feet	Average Winter Temperature	Average Spring Temperature	Average Summer Temperature	Average Autumn Temperature	Average Annual Temperature	Highest Temperature	Lowest Temperature	Average Seasonal Rainfall
Anderson	432	50.0	59.3	80.7	60.2	62.6	114	20	39.97
Auburn	1,363	42.6	56.4	74.3	61.7	59.7	106	13	33.15
Chico	193	47.3	62.4	81.3	64.2	63.8	110	18	20.84
Colfax	2,421	46.0	55.9	76.0	60.2	59.5	106	16	45.16
Cisco	5,939	32.1	42.6	58.9	50.8	46.1	82	0	55.10
Ione	287	49.1	60.5	78.0	64.6	64.0	110	19	20.06
Marysville	69	50.1	62.7	78.3	65.6	64.2	108	18	16.60
Nicolaus	40	50.9	57.7	77.7	61.7	62.0	111	18	19.57
Oroville	171	52.0	64.5	78.8	64.3	64.9	102	20	22.11
Red Bluff	307	46.8	59.8	79.7	63.2	62.4	110	16	27.46
Summit	7,019	28.3	39.1	56.6	48.0	43.0	81	12	44.96
Tehama	220	47.7	61.9	81.3	64.1	63.8	115	21	15.39
Truckee	5,846	27.9	50.6	62.7	50.5	47.9	88	30	------

THE CLIMATE.

The mild climate with which California is blessed is largely owing to the influence exerted by the Japan currents. Similar to the Gulf Stream, this immense tropical river of the sea, crossing from the shores of Asia, courses eastward and southward and strikes our coast, diffusing a genial tinge to the temperature, and making itself felt far down toward the Mexican border. The ocean breezes as they pass over it during the summer months are softened and subdued, and carry its balmy influence to the fair inland valleys, where they render healthful and invigorating the atmosphere, which would otherwise be oppressive. As these winds blow steadily for six months from the westward upon the whole coast line of the State, and there is little variation in their temperature, it follows that there is a general similarity of climate from the northern to the southern boundary, being modified only by the physical conditions of the land. Thus it is found that localities similar as regards neighboring mountain ranges have a similar climate, though one may be five hundred miles north or south of the other. It must be understood that the coast counties which receive, unobstructed, the winds from the sea, have one climate; the small sea coast valleys, separated from the sea by mountain ranges, have another, warmer because more sheltered, and thus more exposed to the influence of the sun; and the great interior valleys have a still higher temperature, because they are hemmed in on all sides by high mountain ranges.

THE TEMPERATURE.

The following table gives the monthly mean temperature at a large number of places in California. The observations were mostly made in the year 1888, and in a majority of cases were compiled by Nelson Gorom, observer, Signal Corps, San Francisco:

Stations.	January	February	March	April	May	June	July	August	September	October	November	December	Annual Means	Highest Observed	Lowest Observed
Almaden	46.6	54.2	54.5	61.2	62.3	68.6	70.6	72.5	69.4	64.2	56.6	54.7	61.3	102	27
Anaheim	55.6	58.5	59.5	66.9	69.9	73.5	71.3	72.1	74.8	69.3	63.4	60.9	66.3	94	34
Aptos	46.0	51.9	53.0	58.4	59.7	67.9	65.9	63.2	61.8	59.1	53.9	54.1	57.9	88	19
Auburn	40.4	50.9	51.3	61.4	61.0	66.9	76.5	79.5	76.9	64.2	52.9	47.1	60.8	105	12
Bishop Creek	33.4	50.9	56.3	69.6	78.1	86.0	87.7	91.7	81.7	65.3	48.9	38.8	65.7	105	3
Boca	15.8	27.6	33.4	42.5	53.4	58.4	67.9	63.6	60.4	43.5	33.5	31.2	44.3	95	39
Byron	41.8	56.5	59.4	69.2	69.5	72.2	80.3	84.5	79.0	69.1	57.9	53.2	66.6	108	22
Caliente	47.0	55.4	53.3	67.9	74.1	75.1	83.5	82.1	82.9	69.7	56.5	52.9	66.7	107	20
Calistoga	44.4	53.7	55.1	60.3	58.5	64.8	63.3	68.7	65.8	61.7	54.7	52.7	59.8	108	22
Chico	42.6	54.9	56.4	70.9	71.6	75.1	86.0	86.2	83.0	67.2	54.7	51.4	67.1	111	18
Cisco	27.8	33.0	34.8	44.8	48.2	51.1	63.4	62.3	62.6	50.2	39.7	35.7	46.1	82	
Colfax	37.8	47.8	49.0	60.4	61.2	65.4	75.0	76.8	73.7	60.9	50.7	47.6	58.9	102	16
Davisville	43.4	50.7	53.1	65.1	66.8	69.9	77.1	76.9	71.4	65.3	57.0	53.5	62.5	111	19
Delta	33.7	45.8	44.4	62.3	66.4	67.4	77.2	76.4	74.6	61.2	54.2	48.7	59.4	105	10
Elmira	44.6	54.4	56.6	64.4	65.4	73.1	78.1	82.5	80.6	65.8	59.0	53.0	64.8	113	24
Emigrant Gap	32.3	40.1	38.7	53.9	53.0	54.7	64.7	67.3	66.7	54.9	43.6	40.4	50.9	86	8
Eureka	44.6	48.1	47.7	50.9	53.0	58.8	56.5	—	56.5	53.0	50.2	53.0	52.0	—	20
Fresno	44.1	53.2	54.1	67.1	68.6	74.0	80.6	83.0	80.3	66.2	53.7	47.8	64.4	111	20
Galt	46.8	47.5	53.1	68.2	68.7	72.7	80.1	78.6	73.8	65.8	56.0	49.6	63.4	108	20
Gilroy	44.8	51.1	52.3	62.0	61.8	71.9	71.4	74.1	70.8	61.7	55.4	51.4	60.7	104	20
Goshen	44.6	54.1	56.9	70.9	74.6	80.7	88.8	90.3	85.8	70.7	58.8	49.0	68.8	110	16
Hollister	47.6	54.3	54.9	60.9	61.3	67.9	68.4	68.4	63.7	59.0	53.9	53.5	59.5	104	21
Hornbrook	22.0	41.3	47.0	58.5	63.9	66.0	70.9	77.4	73.1	57.6	43.2	41.6	55.2	104	12
Indio	47.8	60.3	62.3	75.6	74.2	89.7	96.9	95.4	93.6	79.8	65.0	55.7	74.7	112	22
Ione	42.6	50.6	50.5	61.3	65.4	75.1	80.6	82.3	78.5	67.1	59.9	58.2	64.3	110	17
Knights Landing	41.3	50.5	51.0	60.3	66.3	67.2	74.3	73.6	74.0	64.5	53.6	48.8	60.4	105	20
Lathrop	44.9	52.6	53.3	64.3	65.7	72.6	75.4	75.3	71.1	61.8	54.7	47.8	61.6	112	23
Lemoore	43.8	50.6	53.6	66.8	65.2	74.6	82.8	83.4	82.8	66.0	52.7	46.9	61.1	113	18
Los Angeles	50.0	54.4	55.1	61.9	60.8	67.5	67.9	67.6	68.4	62.0	57.2	55.2	60.7	99	31
Los Gatos									70.8	64.4	55.0	52.4	60.6	—	—
Mammoth Tank	49.6	59.4	63.0	82.0	82.6	93.4	97.2	96.0	93.9	78.6	61.3	52.0	75.7	117	27
Martinez	44.0	53.1	49.7	58.9	58.6	70.7	74.3	68.3	67.8	63.5	54.2	50.8	59.5	94	20
Marysville	54.5	57.5	63.9	70.4	70.2	78.8	81.3	81.4	77.6	67.4	52.7	47.7	67.0	106	20
Menlo Park	45.8	52.5	51.4	59.0	60.4	67.0	70.2	69.5	66.7	61.7	55.2	53.1	59.4	101	20
Merced	47.1	54.6	54.2	65.9	69.3	76.3	83.4	83.0	77.7	68.5	58.0	50.8	65.7	120	20
Modesto	44.2	50.8	54.4	66.2	66.1	73.4	80.9	86.6	80.7	64.7	52.7	50.4	64.3	110	19
Mojave	43.7	52.1	53.7	71.0	67.6	73.1	81.2	85.3	93.9	69.4	58.4	51.8	66.8	115	16
Montague		49.8	49.9	61.9	65.4	65.6	80.3	85.9	74.3	61.9	44.1	40.4	61.8	104	—
Monterey	49.7	54.8	54.6	57.5	60.0	64.8	64.6	63.1	62.5	59.5	53.7	55.2	58.2	90	20
Napa	44.6	49.5	51.8	56.4	60.4	69.8	69.3	67.2	65.8	60.4	52.7	51.0	58.2	100	21
Newhall	45.5	50.9	54.9	65.1	64.0	71.5	77.6	75.2	76.6	63.9	52.9	49.8	62.7	108	14
Oakland	47.4	52.6	51.0	57.6	57.0	62.9	62.5	61.4	60.8	69.1	54.2	52.1	56.6	80	28
Orland	44.5	54.8	53.9	69.0	70.7	75.3	85.1	85.5	84.3	74.8	57.5	51.1	67.2	115	22
Pajaro	47.1	53.1	52.1	56.0	58.3	63.1	63.5	61.4	62.3	60.8	55.6	55.8	57.4	89	20
Paso Robles	44.1	47.8	51.9	62.3	64.0	71.7	73.5	74.4	71.0	60.4	51.3	47.9	60.0	108	13
Petaluma	44.2	50.8	49.0	57.3	57.8	61.2	68.2	67.3	65.0	65.0	55.1	51.3	57.7	97	18
Placerville							74.5	73.2	71.4	57.9	49.9	46.8	62.3	103	—
Pleasanton	48.1	53.7	54.9	61.8	63.4	69.8	74.7	75.7	75.7	67.8	51.3	51.6	62.4	104	22
Red Bluff	40.9	53.9	54.5	67.0	68.1	70.7	80.9	83.6	81.2	68.2	54.8	48.3	64.3	109	18
Redding	39.2	52.4	55.3	69.6	74.2	72.5	83.0	80.9	81.5	66.4	48.5	53.9	64.8	106	18
Rocklin	42.7	49.8	52.5	59.7	64.0	70.2	79.9	82.1	78.4	66.8	55.0	48.5	62.5	106	20
Sacramento	42.8	52.6	53.6	62.3	61.8	67.7	71.6	75.4	73.7	64.2	53.6	48.4	60.6	108	19
Salinas	44.1	49.7	48.6	56.2	58.1	68.4	66.2	60.3	59.3	57.3	50.8	52.2	55.9	87	21
San Diego	51.6	54.9	55.8	60.8	61.2	65.9	68.4	68.4	68.2	63.5	58.8	56.5	61.2	93	33
San Fernando	44.6	52.4	55.6	69.5	62.1	75.1	76.4	74.9	76.7	68.2	58.6	55.1	64.1	108	28
San Francisco	46.3	52.8	52.5	56.2	55.4	61.0	59.1	57.8	59.0	58.6	55.1	52.4	55.5	93	29
San José	46.4	52.6	52.8	58.3	59.8	65.2	66.8	68.6	68.0	62.3	56.5	52.9	59.2	93	22
San Mateo	46.5	51.2	51.7	58.3	58.2	67.1	69.7	66.7	62.8	58.1	49.3	50.6	57.5	92	26
San Miguel	43.2	52.5	54.5	61.2	62.2	69.5	69.9	73.2	70.5	62.5	54.4	50.9	60.4	106	17
Santa Barbara	48.4	56.1	54.8	62.6	62.8	70.7	72.5	69.0	67.0	65.0	59.6	55.8	62.4	82	30
Santa Cruz	49.2	53.1	54.8	59.3	59.3	67.5	66.4	64.4	65.8	66.3	58.0	57.1	60.1	98	24
Sisson			43.4	60.3	45.4	57.1	66.1	69.2	63.1	53.4	44.6	41.0	54.4	104	—
Soledad	42.1	50.4	50.5	59.2	57.6	63.4	64.8	63.7	63.2	58.1	51.1	49.1	56.1	104	16
Soquel	50.3	52.2	53.6	59.6	61.0	68.4	69.5	63.7	61.4	61.3	51.5	55.0	59.0	94	18
Stockton	44.3	51.1	53.6	62.3	62.0	68.1	71.1	74.9	72.3	62.2	53.3	49.6	60.4	102	24
Summit	22.4	30.9	30.5	40.7	45.9	50.1	60.0	59.6	59.7	48.7	35.5	31.7	43.0	81	12
Sumner	46.5	54.9	57.7	73.5	75.7	83.2	91.7	89.4	86.5	68.4	—	—	72.8	110	20
Tehama	41.1	54.6	54.7	65.9	65.4	68.6	78.8	81.1	72.7	64.5	57.9	55.0	63.4	110	21
Towles	34.5	46.4	49.3	53.9	60.9	55.0	69.0	60.8	62.6	54.1	51.3	43.2	53.4	95	8
Truckee	20.2	29.6	53.6	46.5	51.6	56.0	67.3	64.9	61.6	50.6	39.3	34.0	47.9	88	30
Tulare	44.0	51.5	57.0	73.0	75.0	80.5	86.4	85.0	81.1	71.9	61.7	50.2	68.1	113	18
Turlock	45.7	53.2	55.9	64.6	67.0	74.1	78.2	81.6	76.5	65.2	54.6	53.1	64.1	109	21
Williams	46.1	53.4	52.6	64.1	68.9	79.0	87.9	82.9	84.8	74.3	55.1	47.9	66.4	110	19
Willows	40.3	51.1	51.6	64.1	67.2	70.9	79.8	78.8	84.2	67.8	52.5	47.6	63.0	105	20

A PHENOMENAL WINTER.

The phenomenal winter of 1889–90, which is the most severe experienced on the Pacific Coast since the period of American occupation, has played havoc with the meteorological tables of the past. In San Francisco, where the average seasonal precipitation is 23.80 inches, 33.22 inches had fallen up to the twenty-fifth of January. At Auburn, where the average season's rainfall to December thirty-first is 9.22 inches, there had fallen up to that date in 1889, 23.54 inches. At Emigrant Gap, 44.12 inches of rain and snow (the latter reduced in the computation to rain) had fallen for the season up to December, 1889, against 14.18, the average to the same time in previous years. At Dunsmuir, on the California and Oregon line, where the snowfall does not usually exceed four or five feet, the ground was covered to a depth of twelve and fifteen feet. At Grass Valley snow had fallen by the middle of January to such a depth as to shut out all communication with the outside world except by means of snowshoes. On the line of the Central Pacific in the Sierra, the snow, on the twenty-fifth of January, varied from twenty-five feet in depth at Summit, to ten feet at Truckee. While this unprecedented precipitation of rain and snow has caused much interruption to travel and some damage to property in the northern and central portions of the State, it will have the effect of furnishing an abundant amount of water for the service of the miners during the coming summer season. Before the early rains in October last, many weather-wise persons were firmly of the opinion that the year 1890 would be a dry one. They based their belief on the fact that in every thirteenth year since 1851 there had been an insufficient amount of rain. In 1851 the precipitation amounted to but 7.40 inches; in 1864, 10.08 inches, and in 1877, 11.04 inches. These figures are taken from the records at San Francisco, but of course afford a good average for the rest of the States. The heavy downpours, however, which continued during November, December, and January, demoralized the "thirteen-year cycle" people, and the general belief now seems to prevail that the Golden State will never again be visited by what can properly be termed a dry year. The temperature, although there have not been so many severe frosts as in some seasons, has been at most places much lower than last year, which was to be expected from the large amount of rain and snow that has fallen.

Although this report properly closes with the year 1889, because of the severe season and the desire to have as late data regarding the rainfall as possible, this portion of it has been held back for several weeks. The cessation of the great storm on the twenty-fifth of January afforded an opportunity to obtain much matter of value in this connection. Of course, the January reports will be found very imperfect. Because of the serious blockade in the mountains it was found impossible to obtain the regular daily reports that are forwarded to the railroad company. In many instances these reports were sent eastward as far as Denver, and thence telegraphed to this city by way of Mojave. Thus, while the snowfall is greater than ever known before during January, the data at hand fails to show it. By consulting such data as was to be obtained from Mr. Price, the meteorological expert of the Southern Pacific Company, and Lieutenant Maxfield and Sergeant Gorom of the United States Signal Service, a great deal of important and interesting information has been secured. This will be found in the following table, which has been arranged to include the twenty-sixth of January, 1890. It shows the rainfall to that date during the month, also the season's rainfall to December 31, 1889, together with the average seasonal rainfall to December thirty-first, gathered rom observations at a number of stations, extending back from two to forty years. In speaking of the season's rainfall, it must be understood that the calculation begins on the first of July preceding. The rainfall for October, November, and December, 1889, are given separately, and for the purpose of comparison, the average rainfall for the same months in past years. The mean temperature for December, 1889, and the mean annual temperature for December is also given. It should be borne in mind that in reducing the rain to snow, it is estimated that ten inches of the latter make one of the former.

Name of Station.	Season's Rainfall to December 31, 1889.	Rainfall for October, 1889.	Rainfall for November, 1889.	Rainfall for December, 1889.	Rainfall for January, 1890, to twenty-sixth day.	Average Season Rainfall to December 31.	Average October Rainfall.	Average November Rainfall.	Average December Rainfall.	Average January Rainfall.	Mean Temperature for December, 1889.	Average Mean Temperature for December.
Auburn	23.54	5.75	4.85	11.94	7.92	9.22	1.42	3.49	5.94	6.13	47	46
Boca	25.40	1.50	3.65	19.30	*3.50	4.46	0.57	0.91	2.72	4.26	29	29
Chico	20.13	7.80	2.59	9.74	5.54	7.51	1.02	2.39	3.77	3.92		
Cisco	47.25	12.14	9.54	25.57	*10.30	16.37	2.17	4.56	9.25	10.83	31	34
Colfax	41.40	9.95	9.60	21.85	*13.10	14.79	1.74	5.06	7.67	8.36		
Delta	62.58	26.71	10.03	25.83	*2.68	20.52	4.56	6.70	9.21	8.66	42	43
Dunsmuir	52.38	20.15	11.65	20.51	*8.50						29	
Emigrant Gap	44.12	11.81	11.41	20.85	*14.00	14.18	2.45	3.25	8.13	10.18	31	39
Grass Valley	42.32	12.49	8.75	21.08		17.69	2.81	6.06	8.17	10.03		
Ione	14.27	4.71	3.15	6.41	3.41	5.92	0.90	1.67	2.86	2.88		
Iowa Hill	38.73	9.23	8.49	21.04								
Marysville	18.63	5.87	3.73	9.01	5.17	6.17	0.89	1.74	3.33	3.28		
Placerville	36.12	8.85	8.20	19.07	11.31	15.32	2.90	5.48	7.82	9.10		
Red Bluff	21.21	8.39	2.99	9.80	3.27	8.28	1.22	2.84	3.76	2.18		
Redding	37.86	15.13	5.07	17.66	4.62	12.73	1.89	3.62	6.74	3.66	44	43
Rocklin	16.14	4.97	3.68	7.52	4.83	6.26	0.80	1.74	3.59	3.95		
Sacramento	16.90	5.62	2.47	6.37	5.13	7.46	0.68	2.06	4.52	3.77		
San Francisco	24.00	7.28	2.90	13.81	9.22	9.10	0.85	2.85	5.20	5.06	51	53
Sisson	38.41	16.45	5.80	16.13	*9.20						33	
Summit	33.35	8.05	6.80	18.50	*10.40	12.76	2.34	2.82	7.32	8.39	28	31
Tehama	26.44	11.58	3.41	11.45	5.68	5.06	0.74	1.91	2.12	1.37	49	47
Truckee		3.13	3.97	14.51	*6.50	8.00	1.24	2.11	4.35	5.98		
Vina	21.92	7.24	2.59	12.16	4.24						47	

*At these mountain points the wires were down a good share of the time during the month, and the reports were furnished very irregularly. The rainfall, or rather the snowfall, was much heavier than appears from this table.

COAL PRODUCT.

The coal product of the State of California during the years 1888 and 1889, as nearly as can be ascertained, is as follows:

	Tons—1888.	Tons—1889.
Empire Mine, Mt. Diablo District, Contra Costa County	22,000	38,000
Pittsburgh Mining Co., Mt. Diablo District, Contra Costa County	34,795	33,718
Ione Valley Mines, Amador County	24,404	30,000
Chaney Mine, near Elsinore, San Diego County, estimated		5,000
Mines in Fresno County, estimated		2,000
Corral Hollow and Livermore group of mines, Alameda County		3,000
All others, estimated	1,801	
	85,000	111,718

The amounts are given in tons of two thousand pounds each.

For the Empire, Pittsburgh, and Ione Valley Mines, the figures are from the books of the companies. The rest, as stated, are estimated.

THE MANUFACTURE OF GLASS IN CALIFORNIA.

HISTORY, CONDITION, AND FUTURE OF THE BUSINESS.

By Dr. Henry De Groot.

PECULIAR PROPERTIES OF GLASS, AND HOW IT IS MADE.

Glass is made by the fusion at a high temperature of silica with one or more bases, one of which must be an alkali. The material used in its manufacture consists of about 15 per cent alkali, usually soda, and 75 per cent silica, with small quantities of lime and alumina, the other ingredients added depending on the kind of article to be made.

Glass possesses properties both physical and chemical of a very rare kind, adapting it for many useful as well as artistic and ornamental purposes. Besides being hard, brilliant, and transparent, it resists the influence of all common solvents, being acted upon by none of the acids except the hydro-fluoric, which, however, attacks it vigorously, combining with and removing its silica. It withstands the action of the other acids even better than the precious metals. Exposed to water at its ordinary temperature glass is not sensibly affected, though very hot water tends to dissolve it slowly. The surface also becomes clouded through long exposure to a moist atmosphere.

KINDS OF GLASS MADE IN THIS COUNTRY.

The different kinds of glass made in the United States consist mainly of plate, in the several conditions of rough, rolled, ribbed, and polished; flint, including table and other wares, both blown and pressed, together with a large variety of bottles, vials, jars, etc., also a coarser, greenish style of bottle, water glasses, and similar cheap wares. The means by which the fused material is caused to assume its varied forms are by blowing, casting, and pressing into molds, an operation in which the other two processes may be partly combined. In this State the manufacture of glass is at present confined to a small number of articles in the above list, the different kinds of goods made here being fewer now than formerly.

GLASS MAKING IN CALIFORNIA—THE SEVERAL COMPANIES THAT HAVE HERE LIVED AND DIED.

A demand for certain cheap glasswares, such as beer and soda bottles, fruit jars, etc., sprung up here at an early period in our history, the call for other and more costly goods in this line coming in a little later. To meet this demand a San Francisco company, engaged in putting up fruits and vegetables, erected here in 1858 works for making articles for their own use, these being the pioneer glass works on the Pacific Coast. Owing to lack of skill on the part of the workmen, and the inferior quality of the sand employed, the wares turned out proved worthless, whereupon the company, after a vain endeavor to supply these deficiencies, abandoned the enterprise.

A similar venture, entered upon soon after by other parties, having had a similar issue, no further attempt was made to establish here this branch of business until 1863, when the Pacific Glass Company put up a factory on the Potrero, commencing operations the same year. This company, which made all kinds of bottle glass except flint, gave employment to seventy-five men and boys, and produced annually commodities to the value of $130,000. This factory was equipped with one furnace and seven open pots for melting, its capacity having afterwards been somewhat enlarged.

In 1866, the San Francisco Glass Works, giving employment to about forty hands, and producing yearly wares to the value of $40,000, were founded. At this factory were made bottles, jars, demijohns, lamp chimneys, and druggists' articles, besides a few large size retorts for chemists, laboratories, and acid works, these being about the only goods in this line that could at that time be made here with profit.

Nor were the profits realized on these cheap, coarse articles by any means inordinate. It took these pioneer glass makers, in fact, a good while to get the business established on a paying basis. Finding competition for a limited market to be a losing business, these two companies formed, a few years later, a consolidation, and were afterwards conducted under their joint name.

Since that time several other glass manufacturing companies have entered the field, but they have all proved short-lived. Two of these, one operating at Oakland and the other at Berkeley, engaged in the business on a large scale, but after a short trial both closed their works, the venture proving commercially unprofitable. Since the retirement of these parties the San Francisco and Pacific Company alone remains, constituting, it must be supposed, an example of the survival of the fittest. But, while this company has so been able to survive all its contemporaries, it has not, for reasons to be noticed further on, been able, in certain lines of goods, to increase or even maintain its early production. While it turns out more of the articles it continues to make, the products of the factory are not so varied now as they were many years ago.

The property owners and the moneyed men of California have, in times past, been inconsiderately blamed for their lack of enterprise. How little ground there has been for such complaint the history of our domestic industries discloses. Looking back, it is seen that this class of citizens, instead of a lack, have displayed rather an excess of public spirit; millions of dollars having been sunk by them in the vain endeavor to establish in this State a variety of industries prematurely. Hardly a single branch of business can be named but has here its representative in more than one dead failure. True, some of these enterprises have since been resuscitated, and are now on a permanent and prosperous footing. But a greater number have suffered final collapse, with a loss to investors of all the money they ever put in them, and sometimes more besides.

The San Francisco and Pacific Company employs at the present time about one hundred and thirty hands, nearly equally divided between men and boys. Ten years ago they ran two furnaces, now only one, with six pots. Last year they had work for thirty-three glass blowers, this year for only twenty-seven. They make only what is denominated green glass; such as common bottles, druggists' and liquor dealers' wares, fruit jars, carboys, demijohns, etc. Of demijohns, they manufacture one hundred and twenty thousand pieces annually, being about 80 per cent of the number used on this coast. They obtain their sand from Monterey. Formerly, the various companies experimented with sand procured from the neighborhood of Oakland, and even in some instances from the seashore and the sand dunes near San Francisco, but this all proved too impure for even the most common uses.

IMPORTATIONS OF GLASS INTO CALIFORNIA.

The progress that should have been made in the business of glass making in this State has been kept in check through a variety of causes, the chief of these being excessive importations from the Eastern States and Europe; imports from the former having been greatly stimulated of late years through cheap railroad transportation. The total value of this class of goods brought here in 1889 amounted to $2,338,414, divided as follows: $1,528,600 from States east of the Rocky Mountains, and $809,814 from Europe. The imports from the latter consisted of window glass, valued at $63,320; plate glass, $129,079; bottles, demijohns, carboys, etc., $131,826; tableware and medicines, $139,589. From the Eastern States, window glass, $110,000; rough plate, fluted and rolled glass, $16,800; plate glass, $70,000; bottles, demijohns, carboys, etc., $1,000,000; tableware, medicines, colored bottles, etc., $300,000; colored glass, $16,800; bull's-eye insulators, $15,000. The above figures include invoice price, packing, freight, duty, insurance, and exchange; the invoice price amounting to $1,365,092, and the other items to $973,322. For making this quantity of glasswares seven thousand tons of sand would be required. Of the freight money paid on goods shipped here from other States of the Union, two thirds, equal to $341,734, went to eastern corporations. The window glass alone imported into San Francisco during the past two years amounted to eighteen million two hundred and sixteen thousand six hundred and eighty-three pounds, valued at $278,042.

WHY WE HAVE NOT BEEN ABLE IN THIS LINE OF GOODS TO COMPETE WITH MANUFACTURERS ABROAD.

Reviewing the history of glass making in California, the question arises, how comes it that we have not been able ourselves to supply the home demand for articles in this line to a greater extent than we have done? It would seem at first glance as if, with a considerable duty imposed on the foreign importation, and freights on goods of eastern manufacture working in our favor, we could have supplied ourselves with glasswares of the more cheap and bulky kind at least, which, as shown, we have failed to do.

But the answer to this question is ready: it lies in the fact that nearly all the factors of production are much dearer here than in manufacturing countries abroad. Labor, the principal element, is with us from 50 to 60 per cent dearer than in the Eastern States, and nearly twice as dear as in all parts of Europe; capital, insurance, freights, fuel, etc., being also much dearer here than in most other countries.

Again, in the matter of raw material: we have not until recently succeeded in finding on this coast a sand suitable for making glasswares other than of the cheaper and coarser kinds. A former proprietor of the San Francisco and Pacific Works undertook at one time to import sand from Belgium, but, although brought here as ballast, the experiment failed owing to the duty to which the sand was subjected.

Nor is it alone in the higher grade wares that the home manufacturer is in this respect placed at a disadvantage. Even in the making of beer bottles he cannot quite compete with the German article, the iron in our California sand making it impossible to produce here a bottle wholly acceptable to the trade. To get rid of this iron, which would require the employment of expensive chemicals and an intense heat, would cost too much to warrant its elimination. It is claimed, too, that the imported is in some other particulars better than the home-made bottle, being smoother and seamless, and, therefore, handsomer and stronger. To correct these defects would require so much additional labor that the California manufacturer finds it expedient to turn out a cheaper and less attractive article, even though it do not meet all the requirements of the market. Our brewers, for instance, for their exported beer, which has first to be steamed, have need for a very strong bottle, stronger than those made by either the local or the foreign manufacturer. They, therefore, for this particular use, get their bottles from the East, these proving to have greater strength than any others.

When it comes to a certain class of wine makers they, too, have in this connection a grievance, real or affected, objecting to the California bottle for putting up their clarets, on the ground that it lacks that peculiar shade or tint imparted by the foreign manufacturer, and which it is alleged cannot be produced either here or elsewhere in the United States. Nearly all our vintners are, in fact, using imported wares for bottling their wines, assigning for this course reasons similar to the above, all seemingly more or less whimsical.

As, however, the eye and even the fancy has to be consulted in these matters, as well as the taste, the commercial instinct recognizes the necessity of catering to these caprices of trade, even though they have little or no foundation in reason. It behooves, then, the California manufacturer to study carefully these special requirements and minor defects of the business, addressing himself to meeting the one and curing the other as far as may be. But, after all,

THE GREAT TROUBLE IN THIS STATE—

The one insurmountable obstacle that has barred the progress of the glass-making industry—has been the absence here of a sand adapted for making the finer and higher priced goods of this kind; nor until this desideratum is supplied, can the business be much advanced beyond its present feeble and dwarfed condition.

To fill this long standing and vital want, the most strenuous endeavors have been made, much time and money having been expended to that end. The whole coast has been explored by those out on this and similar errands. Hunters after coal and other of the useful minerals, as also prospectors for the precious metals, have, while in the field, had an eye to the discovery of this almost equally precious sand, for which the glass manufacturers have always held themselves ready to pay a liberal bonus. But not until the past year have these efforts been rewarded with success, there being now no room to doubt that a very extensive bed of glass sand, and of the very best quality, has been discovered in this State.

THE NEW FIND—ITS SITE AND PROBABLE IMPORTANCE.

The deposit above alluded to is located in the western part of Placer County, near the town of Lincoln, and immediately on the line of the California and Oregon Railroad. The history of this discovery is briefly as follows: Mr. F. H. Rosenbaum, of San Francisco, for many years an importer of and large dealer in mirrors and other high grade glasswares, impressed with the importance of finding in this State a better glass sand than had yet been met with, employed a thoroughly qualified expert, and sent him to prospect for such deposit. Having visited various parts of the State and spent many months without satisfactory results, these parties, principal and employé, repaired to the State Mining Bureau, in the hope that they might be able to there obtain some useful hints and, perhaps, helpful information. In this they were not disappointed. The Bureau had in its possession a sample of what the analytical chemist attached to that institution had tested and determined to be a good glass sand, the same having been procured from the vicinity of Lincoln.

With this clue, and much additional information calculated to further the object of this search, this expert, providing himself with suitable boring apparatus, proceeded at once to Lincoln, and there commenced boring on a tract of land adjoining the town, and known as the Pyremont Ranch.

On this tract, which comprises two hundred and forty acres, since secured by Mr. Rosenbaum, twenty-five prospecting holes were put down, the following strata having been passed through: top soil, a red loam, a pure white sand; white kaolin, yellow kaolin, fire-clay of various colors, red and blue brick-clay, lignite, with indications of harder coal beneath it.

The kaolin and the clays, which appear to extend over the entire tract, occur in strata varying from one to forty feet in thickness, and represent millions of tons. The sand, as nearly as could be determined by the borings made, reaches within the limits of the ranch one million three hundred and twenty-six thousand tons, and may amount to much more. By the same test the lignite has, over an area of one hundred and twenty acres, an average thickness of ten feet, representing two million tons at least. There is water enough on the premises for both mining and manufacturing purposes, even though prosecuted on the most extensive scale.

The mass of this sand, as shown by analysis, consists of 97.29 silica, being practically a pure article. Experts who have examined it pronounce it as good as any ever yet found. Glass of the very best quality has, in fact, been made from it. The lignite burns freely, being of the same character as the considerable quantities obtained in the neighborhood, and which has been successfully used for generating steam in the large pottery works of Gladden & McBean, at Lincoln; also in the flouring mills at Sacramento, Marysville, and elsewhere.

MAY CHANGE THE WHOLE ASPECT OF THE BUSINESS IN CALIFORNIA.

If the expert of Mr. Rosenbaum has not been mistaken in his estimates, it may be expected that a new phase will in a short time be put on the glass-making business of California, inasmuch as a good sand, and an available fuel occurring in conjunction, are enough to insure for this industry a prosperous future. A company has already been formed for the purpose of opening up these deposits, and erecting works for the manufacture of glass on the spot. That the enterprise, if properly managed, will result in a great success can hardly be doubted, as this company will be able to make that line of goods that cannot now be produced here, but which everywhere affords the largest profit. Besides, the demand for wares of this kind are destined to undergo in California large and rapid increment. The present requirements of our wine makers and our fruit growers are nothing compared with what they soon will be. At the rate our population is increasing, the general wants of the country in this line will be doubled in the course of a few years.

In the large eastern factories, where a great variety of goods are made, the workmen are confined to a single line, at which they become very expert, performing more and doing better work than when their attention is divided among several things. A large company might adopt the same practice here, gaining thereby similar advantages, the limited number of articles we now make rendering this subdivision of labor impracticable. A new company entering the field would in fact be able to adopt all the most recent methods, processes, and appliances that have met with approval elsewhere. They could avail themselves of all prior experience, adopting at the start what might have cost their predecessors in the business a great deal to test and establish.

NEW PROPERTIES AND USES.

Then, there is no knowing what additional properties may yet be developed in glass nor the many new uses to which it may hereafter come to be applied. Every year something is evolved imparting to this substance additional value. Already glass railroad sleepers have been substituted for iron with some success, they proving to be much cheaper while they are nearly as strong as castiron. Practically they are imperishable as regards climatic changes, the influence of the atmosphere, and the ravages of insects.

For flooring, glass has come into large use, being adopted where much light is required in cellars. It costs but little more than wood, while it absorbs no impurities and is easily kept clean. A process has been perfected whereby glass can be made pliable. Though it soon parts with this property there is but little doubt but means will yet be discovered by which it can be made permanent. Mr. Frederick Siemens, of Dresden, has discovered a method whereby an unwonted degree of hardness and strength can be communicated to glass, greatly increasing its fitness for the manufacture of domestic utensils and also for building material and similar uses.

In short, the manufacturer of glass in planning for the future might presume a great deal on the chances of its undergoing heavy and important improvements, adapting it for purposes of which we can now form no conception.

MINERAL PRODUCTS OF THE UNITED STATES IN 1888.

The sixth report on the "Mineral Resources of the United States," by David T. Day, Chief of the Division of Mining Statistics and Technology, United States Geological Survey, shows the following totals of the more important mineral substances produced in this country during the year 1888:

METALS.

Iron and Steel.—The principal statistics of 1888 were: Domestic iron ore consumed, about 12,060,000 long tons; value at mines, $28,944,000. This is an increase over 1887 in quantity of 760,000 tons, but a decrease in value of $4,956,000. Imported iron ore consumed, 587,470 long tons; total iron ore consumed in 1888, about 12,650,000 long tons, or 150,000 tons more than in 1887. Pig-iron made in 1888, 6,489,738 long tons; value at furnace, $107,000,000. This is an increase over 1887 of 72,590 tons in quantity, but a decrease of $14,925,800 in value. Steel of all kinds produced in 1888, 2,899,440 long tons; value at works, $89,000,000. This is a decrease from 1887 of 439,631 tons in quantity and of $14,811,000 in value. Total spot value of all iron and steel made in 1888, in the first stage of manufacture, excluding all duplications, $145,000,000, a decrease of $26,103,000 as compared with 1887. Limestone used as a flux in the manufacture of pig iron in 1888, about 5,438,000 long tons; value at quarry, about $2,719,000.

Gold and Silver.—According to the Director of the Mint the gold product was 1,604,927 fine ounces, valued at $33,175,000. This is about the same as in 1887, being an excess of only $75,000. The silver product was 45,783,632 fine ounces, of the commercial value of about $43,000,000, and of the coining value of $59,195,000. This is an increase of 4,515,327 ounces over the product in 1887. In addition to the product of our own mines some 10,000,000 ounces of silver were extracted in the United States from foreign ores and bullion.

Copper.—The total product, including the yield of imported ores, increased to 231,270,622 pounds, or 115,635 short tons, during 1888, which is 46,053,291 pounds more than the product of 1887. During the first quarter of 1889 the production was increasing at even a more rapid rate. The prices received by American producers averaged 15½ cents per pound for Lake copper, 14½ for Arizona, and 14 for other districts; making the total value $33,833,954. Montana led in the production, making 97,897,968 pounds. Consumption was somewhat reduced by the high prices.

Lead.—The product increased to 180,555 short tons from 160,700 tons in 1887. The increase was due principally to the heavier receipts of lead in Mexican silver-lead ores from 15,000 tons in 1887 to over 27,000 tons in 1888. The average price in New York was 4.41 cents per pound. The production of white lead, chiefly from pig lead, was 89,000 short tons, valued at $10,680,000.

Zinc.—The erection of new works and the extension of old ones led to a further notable increase in the production of zinc in 1888. The additions to capacity were fairly uniformly distributed in the West, East, and South.

Production in 1888, 55,903 short tons, with a total value of $5,500,855; in 1887, 50,340 tons, worth $4,782,300. The production of zinc white in 1888, directly from ores, was 20,000 short tons, worth $1,600,000.

Quicksilver.—The product was 33,250 flasks (of 76½ pounds each) from California, a decline in that State of 510 flasks from 1887 in spite of a very satisfactory price, which averaged $42 50 per flask, making the total value $1,413,125. No new valuable deposits were discovered in 1888, and without them it is not probable that the yield of quicksilver will increase.

Nickel.—The industry remains unchanged except for indications of further developments at Lovelocks, in Nevada, and Riddle, Oregon. The product includes 190,637 pounds of metallic nickel, valued at $114,382, at 60 cents per pound, and 4,545 pounds, worth $1,136, exported in ores and matte. Total value, $115,518. The corresponding value in 1887 was $133,200.

Cobalt Oxide.—The total product, including the contents of the exported ores and matte, was 12,266 pounds, worth $18,441. In 1887 the total was 18,340 pounds, worth $18,774, the lower rate of value in that year resulting from a larger proportion of exported nickel in matte and ore. The price of cobalt oxide remained at $2 per pound.

Chromium.—The product declined from 3,000 tons in 1887 to 1,500 tons in 1888. The average price in San Francisco remained $15 per ton. Increased operations are probable in 1889.

Manganese.—The product of manganese and manganiferous iron ores in the United States in 1888 was 239,460 tons, valued at $876,215. Of this amount some 25,500 tons would be classed as manganese ores; the remainder as manganiferous iron ores. Of the manganiferous iron ores, 11,462 tons, averaging 11 per cent of manganese, and 189,574 tons, averaging 4 per cent of manganese, were from the Colby Mine, Michigan. In addition to the above, some 60,000 tons of argentiferous manganese ores, valued at $10 a ton, chiefly for the silver contained in them, were produced in the Rocky Mountain region.

Aluminum.—The past year was more promising than ever before for the production of cheap aluminum. The production of metallic aluminum as an industry distinct from the production of alloys began toward the close of the year, and 500 pounds had been made up to December 31; the production of 3,000 pounds since then indicates that the industry may continue. The exact amount of alloys produced by the Cowles process has not been furnished, but was not markedly different from the product of 1887, when 18,000 pounds of aluminum contained in bronze and ferro-aluminum were produced. The price for metallic aluminum declined to as low as $4 50 per pound for less favored brands.

Platinum.—Including the platinum and iridium separated from gold by the assay offices, and that saved in placer gold mining, the product was about 500 ounces, valued at $2,000.

FUELS.

Coal.—The total production of all kinds of commercial coal in 1888 was 142,037,735 short tons (increase over 1887, 18,022,480 tons), valued at the mines at $204,221,990 (increase, $30,625,994). This may be divided into Pennsylvania anthracite 43,922,897 short tons (increase, 4,416,642 short tons), or 39,216,872 long tons, including 38,145,718 long tons shipped by the railroads and canals and reported by their statistician, Mr. John H. Jones, and 1,071,154 long tons sold to the local trade at the mines (increase, 3,943,430 long tons), valued at $85,649,649 (increase, $6,284,405); all other coals, including bituminous, brown coal, lignite, small lots of anthracite produced in Colorado and Arkansas, and 4,000 tons of graphitic coal mined in Rhode Island, amounting in the aggregate to 98,114,838 short tons (increase, 13,605,838 tons), valued at $118,572,341 (increase, $24,341,589). The collier consumption at the individual mines varies from nothing to 8 per cent of the total output of the mines, being greatest at special Pennsylvania anthracite mines and lowest at those bituminous mines where the coal bed lies nearly horizontal, and where no steam power or ventilating furnaces are used. The averages for the different States varies from 2 to 6.4 per cent, the minimum average being in the Pennsylvania bituminous and the maximum average being in the Pennsylvania anthracite region. The total output of the mines, including colliery consumption, was: Pennsylvania anthracite, 41,624,610 long tons (increase over 1887, 4,045,863 long tons), or 46,619,564 short tons (increase, 4,531,367 short tons); all other coals, 102,039,838 short tons (increase, 14,152,478 tons), making the total output of all coals from mines in the United States, exclusive of slack coal thrown on the dumps, 148,659,402 short tons (increase, 18,683,845 tons), valued as follows: Anthracite, $89,020,483 (increase, $4,468,302); bituminous, $122,497,341 (increase, $24,492,685); total value, $211,517,824 (increase, $28,960,987). The above figures show a notable increase in 1888 over 1887 in the aggregate output and value of both anthracite and bituminous coal, although not as great an increase as occurred in 1887 over 1886 in the value of the anthracite, or in the total tonnage of the bituminous coal.

Coke.—The production of coke in the United States in 1888 was 8,527,560 tons, valued at about $14,000,000. Pennsylvania produced by far the largest amount, the Connellsville region alone producing 4,952,553 tons; West Virginia, 528,533 tons; Alabama, 518,511 tons; Tennessee, 385,693 tons, and Virginia, 149,099 tons.

Petroleum.—The product of petroleum in the United States in 1888 was 27,346,018 barrels (of 42 gallons each), valued at about $24,598,559. Of this amount Pennsylvania produced 16,491,083 barrels; Ohio, 10,010,868 barrels; West Virginia, 119,448 barrels; California, 704,619 barrels; and other States, 20,000 barrels.

Natural Gas.—The amount of natural gas consumed is given in coal displacement; that is, the amount of coal displaced by the use of natural gas. It is estimated that the amount of coal displaced by natural gas in the United States in 1888 was 14,163,830 tons, valued at $22,662,128. Of this amount 12,543,830 tons were displaced in Pennsylvania; 750,000 tons in Ohio, and 660,000 tons in Indiana.

STRUCTURAL MATERIALS.

Building Stone.—Direct returns from producers of the various kinds of building stone show that there was but a small gain in value over the figures of 1887. The value of the stone produced in 1888 is $25,500,000, or $500,000 more than in the preceding year.

Brick and Tile.—Value $48,213,000. This figure represents only a small gain over 1887. This is due rather to increase in the number of manufacturing plants than to increased production at the older and more important sources of supply; in fact, many of the latter show a falling off in production. Prices also were generally somewhat lower than in 1887.

Lime.—The production is estimated at 49,087,000 barrels, with an average value of 50 cents per barrel, making a total of $24,543,500 as the value of the year's product. These figures are not largely in advance of those for 1887, and the gains are not so much the results of increased production in the leading lime regions as in localities of minor importance.

Cement.—The amount of cement produced in 1888 is less than for 1887, being 6,253,295 barrels for 1888, valued at 72½ cents per barrel, making $4,533,639 as the value of the year's product.

ABRASIVE MATERIALS.

Buhrstones.—The product which is used for grinding cement, plaster, paints, feed, etc., comes from New York, Pennsylvania, and North Carolina, and is valued at $150,000.

Grindstones.—Ohio and Michigan furnish practically all the sandstone from which grindstones are made. The product in 1888 increased slightly, 41,000 long tons, worth $281,800, being produced, against 37,400, worth $224,400, in 1887. The price varied from $6 50 to $10 per ton at the quarries before being finished into grindstones.

Corundum.—Production is limited to the old mines in North Carolina and Georgia; 589 short tons, valued at $91,620, were produced in 1888, against 600 tons in 1887.

Oilstones and Whetstones.—The production of novaculite from Arkansas increased slightly, making the total, including Labrador oilstone, etc., 1,500,000 pounds, valued at $18,000 in the rough state.

MISCELLANEOUS.

Precious Stones.—No systematic mining was carried on in search of gems in 1888. But in mining for other substances, and in chance discoveries, gems worth $64,850 in the rough state, and gold quartz worth $75,000, were found.

Phosphate Rock.—The production declined to 433,705 long tons, but the total value increased slightly to $1,951,673 on account of better prices. The trade in manufactured fertilizers was very prosperous.

Marls.—The production in the Southern States, particularly in Virginia, North Carolina, Alabama, Mississippi, and Florida, is increasing, while the product of New Jersey did not vary from 1887. About 600,000 tons, valued at $300,000, were produced.

Salt.—The industry shows only slight changes: In 1888, the production was 8,055,881 barrels of 280 pounds, valued at $4,377,204. In 1887, the product was 8,003,962 barrels, worth $4,093,846. Kansas became a commercial source of salt in 1888, producing 155,000 barrels, with a prospect of still greater increase in 1889.

Bromine.—The product was 307,386 pounds, worth $95,290, an increase from 199,087 pounds in 1887, worth $61,717. The price remained at 31 cents per pound.

Borax.—The production was restricted to 7,589,000 pounds, worth $455,340, at 6 cents per pound for the average quality. In 1887 the product was 11,000,000 pounds, worth 5 cents per pound.

Sulphur.—The sulphur refinery in Utah was partially burned. This and litigation over the property prevented any production in 1888. The supply came principally from Sicily, with small importations from Japan. It was practically all made into sulphuric acid.

Pyrites.—Production 54,331 long tons, valued at the mines at $167,658; a slight increase in quantity over the previous year.

Barytes.—The production from Missouri, Virginia, and New York increased to 20,000 long tons, worth at the mines $110,000. In 1887 the product was 15,000 long tons, worth $75,000.

Gypsum.—The domestic supply comes principally from Ohio and Michigan, with smaller amounts from New York, Virginia, Kansas, Colorado, California, Dakota, and Utah. The product in 1888 was 96,000 short tons of crude gypsum, valued at $430,000. A large portion of the supply is imported from Nova Scotia, where 126,118 tons, worth $121,579, were produced in 1888.

Ozocerite.—From the region of Soldier's Summit, Utah, about 20,000 pounds of crude mineral wax were produced, worth $1,000 in New York, where the material was sold. An increase is probable in 1889.

Soapstone.—Production, about 15,000 tons, worth $50,000 before shipment.

Asphaltum.—The product of 1888 includes 700 tons of gilsonite, mined in Utah; 3,100 tons of ordinary asphaltum, principally from California; and 50,000 tons of bituminous rock, quarried in California for pavements in competition with asphaltum. Total value, $331,500.

Feldspar.—The consumption for potters' use declined to 8,700 long tons, worth, in Trenton, New Jersey, $50,000. In 1887 10,200 long tons were produced, worth $56,100.

Flint.—For potters' use the consumption was 16,250 long tons. Including that for sandpaper and for glass, the consumption was about 30,000 tons, worth, underground, $175,000.

Potters' Clay.—The consumption included 18,000 long tons of kaolin or china clay, 5,250 tons of ball clay, and 13,500 tons of fire clay, worth altogether $300,000.

Mica.—Owing principally to the use of smaller sizes in stoves, the production of sheet mica decreased from 70,500 pounds in 1887 to 48,000 in 1888, valued at $70,000. There is increased demand for mica waste.

Mineral Paints.—The product, including ocher, metallic paints, and small amounts of umber and sienna, increased to 24,000 long tons, valued at $380,000.

Graphite.—The production of pure graphite was limited to Ticonderoga, New York, and is reported as unchanged. The total production of pure material was 400,000 pounds, worth $33,000. Small amounts of less pure material, for foundry facings, etc., were produced in North Carolina, and at Cranston, Rhode Island.

Fluorspar.—The production, limited to the neighborhood of Roseclare, Illinois, and Evansville, Indiana, is reported at 6,000 tons, worth $30,000, an increase of 1,000 tons over 1887.

Infusorial Earth.—The product came principally from Maryland, and amounted to 2,500 short tons, worth, before shipment, $12,500.

Zircon.—During 1887 and 1888, 25 tons of zircon were mined, principally in Henderson County, North Carolina, and sold for $10,000 for the manufacture of incandescent gas burners. About 4 tons of monazite, one ton of allanite, 600 pounds of samarskite, and $500 worth of yttrium minerals were produced for the same use. About 6 tons of monazite and 5 tons of cerite were also imported.

Mineral Waters.—Amount sold in 1888, 9,628,568 gallons, valued at $1,709,302. In 1887 the product was 8,259,609 gallons, worth $1,261,473.

METALLIC PRODUCTS OF THE UNITED STATES IN 1888.

	Quantity.	Value.
Pig iron, spot value, long tons	6,489,738	$107,000,000
Silver, coining value, troy ounces	45,783,632	59,195,000
Gold, coining value, troy ounces	1,604,927	33,175,000
Copper, value at New York City, pounds	231,270,622	33,833,954
Lead, value at New York City, short tons	180,555	15,924,951
Zinc, value at New York City, short tons	55,903	5,500,855
Quicksilver, value at San Francisco, flasks	33,250	1,413,125
Nickel, value at Philadelphia, pounds	195,182	115,518
Aluminum, value at Philadelphia, pounds	19,000	65,000
Antimony, value at San Francisco, short tons	100	20,000
Platinum, value (crude) at New York City, troy ounces	500	2,000
Total	----------	$256,245,403

NON-METALLIC MINERAL PRODUCTS OF THE UNITED STATES IN 1888 (SPOT VALUES).

	Quantity.	Value.
Bituminous coal, long tons	91,106,998	$122,497,341
Pennsylvania anthracite, long tons	41,624,610	89,020,483
Building stone	----------	25,500,000
Lime, barrels	49,087,000	24,543,500
Petroleum, barrels	27,346,018	24,598,559
Natural gas	----------	22,662,128
Cement, barrels	6,253,295	4,533,639
Salt, barrels	8,055,881	4,377,204
Limestone for iron flux, long tons	5,438,000	2,719,000
South Carolina phosphate rock, long tons	433,705	1,951,673
Zinc white, short tons	20,000	1,600,000
Mineral waters, gallons sold	9,628,568	1,709,302
Borax, pounds	7,589,000	455,340
Gypsum, short tons	96,000	430,000
Manganese ore, long tons	25,500	255,000
Mineral paints, long tons	24,000	380,000
New Jersey marls, short tons	600,000	300,000
Pyrites, long tons	54,331	167,658
Flint, long tons	30,000	175,000
Mica, pounds	48,000	70,000
Corundum, short tons	589	91,620
Sulphur, short tons	----------	----------
Precious stones	----------	64,850
Gold quartz, souvenirs, jewelry, etc.	----------	75,000
Crude barytes, long tons	20,000	110,000
Bromine, pounds	307,386	95,290
Feldspar, long tons	8,700	50,000
Chrome iron ore, long tons	1,500	20,000
Graphite, pounds	400,000	33,000
Fluorspar, short tons	6,000	30,000
Slate ground as pigment, long tons	2,500	25,000
Cobalt oxide, pounds	12,266	18,441
Novaculite, pounds	1,500,000	18,000
Asphaltum, short tons	53,800	331,500
Asbestus, short tons	100	3,000
Rutile, pounds	1,000	3,000
Total	----------	$328,914,528

Recapitulating the items contained in the above table, the value of the minerals produced in the United States in 1888 was as follows:

Metals	$256,245,403
Mineral substances	328,914,528
	$585,159,931
Estimated value of mineral products unspecified	6,500,000
Grand total	$591,659,931

The mineral product of 1888 shows an increase of nearly fifty millions over that of 1887, which was the largest by $77,000,000 of any made in the history of the country. The large product of 1888 was due in part to the high price of copper, which increased it to the extent of $13,000,000 above what it would have been had that industry remained in a normal condition. This increment was, however, partially counteracted by the decline in the total value of pig iron. The other leading factors of increase consisted mainly of coal and other fuels concerned in the production of mineral substances.

GOLD AND SILVER.

Adopting the figures given by the Director of the Mint, this report makes the total commercial value of the gold and silver produced in the United States for the year only about $76,000,000, which figures are probably not much out of the way. The bullion output of the Pacific States and Territories, for the year, was by local statisticians returned at $114,341,592, but nearly one quarter of this, as stated elsewhere in this volume, consisted not of the precious metals, but of copper and lead. In addition to the silver produced by our own mines, some ten million ounces of that metal were extracted from foreign ores and bullion imported into this country, the greatest portion coming from Mexico. From the more liberal policy likely to be adopted by our Government in regard to this metal, it may be expected that silver mining will undergo early improvement on this coast. It has, in fact, already done so in so far as the prices of the white metal are concerned, figures having advanced from 92 cents per ounce, early in the year, to 96 cents, present quotations on the New York market. The fear of a glut of silver is disappearing since it became evident that it is the product of gold that is making the more rapid advance, when the whole field of production is taken into consideration. Looking to the future, there is more reason to apprehend a scarcity of silver than of gold, the productive sources of the latter being multiplied and expanded at much the more rapid rate. The Comstock Lode is turning out at present nearly as much gold as silver, nor is there much prospect of the present relations here maintained between the two metals undergoing early change. In California the product of silver has for several years past been growing less, while that of gold has been on the increase. Looking abroad it will be observed that the output of gold is everywhere being enlarged, while that of silver is standing still. Australia, Siberia, South and Central America, Africa, and India are all growing gold producers, but they turn out very little silver.

COPPER.

The enormous copper output of 1888 has, during the current year, suffered considerable curtailment, the reduction being estimated by the most intelligent authorities at 12 to 15 per cent, a result due partly to lower prices and partly to incidental causes, such as the fire at the Anaconda Mine, unexpected delays in completing California plants, etc. The price of copper, which throughout 1888 had averaged about 16 cents per pound, began, early in the present year, to show signs of weakening, and, declining slightly towards the end of the first quarter, reached its minimum, 10¾ cents, early in the month of September, soon after which the market took an upward turn, and has since been steadily growing stronger, the price of Lake being quoted December twentieth at 14 cents per pound on the New York market. While this advance may have been due in part to the concerted action of large holders in manipulating the market, there can be no doubt but that the supply on hand has become much reduced, many of the smelters even being comparatively bare of stock. While the present price will tend to stimulate production, there is not much danger that it will greatly exceed consumption, at least for some time to come, as the demand for this metal, while it keeps pace with the growth of all other industries the world over, is likely to be further increased by several new uses to which it is about being put. If the German Government should employ the new powder, as talked of, the requirements for manufacturing cartridges will absorb a large amount of the European product of copper. The large stock of this metal originally held by the French syndicate, and the disposal of which so upset the market last spring, has been reduced to the extent of sixty thousand tons during the last eight months, leaving in the hands of that institution a balance so inconsiderable that it can no longer exercise a controlling influence.

LEAD.

As with copper, so has there also been some falling off in our domestic production of lead the present year, though the decline in this instance has not been so marked, nor has it extended to so many lead-producing localities—Idaho, Nevada, and Montana being the countries most involved in this reduction. As for Nevada, its entire output has not amounted to one hundred tons for the year, against several thousand tons turned out only a few years ago. California, never a large producer of lead, has made none whatever for some time past, though it is now probably on the eve of regaining its status in this respect through the reopening and active working of the Cerro Gordo Mines, Inyo County, where alone has any considerable quantity of lead ever been produced in this State. The small amounts of lead-silver bullion turned out of late in Nevada and Arizona have gone east, the former to Salt Lake and the latter to smelters in Colorado and New Mexico for parting and refining.

QUICKSILVER.

The California product of this metal—thirty-three thousand two hundred and fifty flasks in 1888—did not probably exceed thirty thousand flasks the present year, and this, notwithstanding the price has been meantime steadily advancing. It is the case, too, that operations have during the year been resumed on several deposits of cinnabar, that had been opened and equipped with plant some time ago, but on which work was suspended on the occurrence of extreme low prices.

The Gypsy Mine, located in Lone Tree District, San Benito County, has within the last few months been brought into production, turning out since about thirty flasks of metal per month. Efforts made last summer to reopen and work the Altoona Mine, Trinity County, having been defeated, by reason of disputed title, that valuable property remains idle, although known to contain a large body of high grade ore. Quicksilver, worth at the opening of the year, 54 cents per pound, has since advanced to 63 cents, the price at which it is now quoted on the New York market. That production has failed to respond to this advance in the price of the metal finds explanation in the fact that owners deem it expedient to husband the resources of their mines, which, through an overestimate of their extent, were at one time being depleted at a ruinously rapid rate. The ore of this metal being restricted to a few countries, and to a limited area in each, suggests economy in disposing of it, wherefore no great overproduction of quicksilver is likely to occur hereafter. If enough be turned out to meet the growing requirements of consumption this is all that can be expected in the future.

BORAX.

The product of this salt for the current year amounted to seven million six hundred thousand pounds against seven million five hundred and eighty-nine thousand pounds in 1888; the output having been, as for the preceding two years, somewhat restricted through concerted action of producers; price slightly higher than last year, average 7¼ cents per pound, 7 for concentrated, 7½ for powdered and refined, these being car and cargo rates. Of the borax crop of the United States about 70 per cent is made in California, the remainder in Nevada. About the middle of the year a new company operating in Saline Valley, Inyo County, began making borax, and have since turned out the refined article at the rate of about forty tons per month. A rich deposit of the borate of lime was discovered during the year immediately on the seashore in the southwestern corner of Oregon. Being conveniently located for shipment, this material is to be taken to East Oakland for reduction, works having been there erected for the purpose.

PETROLEUM.

Statistician Day credits California with an oil production of eight million seven hundred and nineteen thousand nine hundred and ninety-eight gallons for the year 1888, a quantity that has since been increased to nine million gallons, or a little more. The oil industry of this State is in a healthy condition, being on a good basis, and making some progress every year. The Pacific Oil Company, the largest operator in the field, has bored four new wells during the present year, all of which are active producers, the wells previously sunk by them also continuing to yield with but little diminution. This company has always four or five wells in process of sinking, these new contributors more than keeping good their supply. The company's two refineries have been running steadily throughout the year; the larger, located at Alameda Point, has been run to its full capacity, and made a heavy output of the refined article. With the other large company, the Mission Transfer, this has also been an active year; some new wells having been bored, and their usual complement of the crude material produced. Outside the territory of these two companies several new wells have been put down, some of which are now yielding oil. But, with all this increase, our California wells come far short of meeting local requirements, the importations of manufactured petroleum into the State being still very large. There should be more wells put down here; the present flow hardly suffices to keep our refineries constantly busy.

Boring for natural gas, a business confined mostly to the neighborhood of Stockton, has met with some success during the year. The issue from one of the wells bored there to a depth of one thousand one hundred feet has, for several months past, equaled twenty thousand cubic feet of gas per twenty-four hours.

Of our other and less important mineral products alluded to in the above report, it may be observed that, owing to the shortness of the evaporating season, the product of California salt has been less by several thousand tons this year than last; so, also, has the output of chromium, by reason of low prices, been somewhat less. Of manganese, used in ore reduction, about one hundred tons have been mined. The output of coal, cement, gypsum, antimony, asbestus, etc., never large, has been slightly increased, while of building stone much more has been quarried than ever before.

INDEX.

A

	PAGE.
Abrasive materials of United States	333
Acme Claim, San Diego County	142
Altitudes, San Diego County, list of	153–154
Aluminum product of United States, 1888	331
Amalgamation	130
Anacapa Islands	155, 171
“Ancient rivers,” theories of genesis of	107–108
Argentiferous ores, California	25, 26
Asbestus, San Bernardino County	236
Asbestus, San Diego County	148, 149
Asphaltum, Santa Clara County	55
Asphaltum, United States, 1888	334
Auriferous beach sands of California	35
Auriferous gravels of California. By John Hays Hammond, E. M.	105–138
Auriferous gravels of San Gabriel Range, San Bernardino County	236–237

B

Baker Divide Drift Mine, Placer County	29
Bald Mountain Extension Drift Mine, Plumas County	28
Bald Mountain Gold Mine, San Bernardino County	237
Bald Mountain Mine, Sierra County	120
Bar mining by drifting	278
Bar mining by elevators, deep	278
Barnes, Geo. E. Meteorological	312–322
Barytes, United States, 1888	333–334
Basalt in Santa Clara County	51–52
Baughart Mine, Shasta County, California	38
Bay State Drift Mine, Butte County	28
Bay View Claim, San Diego County	142
Beaches of California, gold bluffs and	35–36
Beauregard Mine, San Bernardino County	234
Bedrock mining	114
Bessemer No. 1 Mine, San Bernardino County	236
Big Bend Tunnel, Butte County	30-31, 273
Big Blue Claim, San Diego County	146
Black Hawk Mines, San Bernardino County	226
Blue Bell Claim, Lassen County	212
Blue Jacket Mine, San Bernardino County	230
Blue Jay Mine, San Bernardino County	230
Blue Wing Drift Mine, Placer County	29
Bob Lewis Channel, cross-section of	115
Bonanza Claim, Tuolumne County	37
Borax production of the United States, 1888	333, 338
Borax, San Bernardino County	215, 225
Boss Mine, San Bernardino County	229
Bowers, Dr. Stephen. Report on San Nicolas Island, Ventura County	57–61
Breece & Wheeler Drift Mine, Placer County	29
Brick and tile, United States, 1888	332
Brier Mining District, San Bernardino County	222
Bromine, production of, in United States, 1888	333
Browne, Ross E. Reference to future report on Drift Mining Districts of Forest Hill, Placer County	45–46
Brush Hill Claims, Nos. 1 and 2, Lassen County	212
Buckman's Springs, San Diego County	140
Buhrstones, product of United States, 1888	333
Building stone, Los Angeles County	209
Building stone, San Bernardino County	224, 225
Building stone, Santa Clara County	53–54

PAGE.

- Building stone, United States, 1888 332
- Bullion Ledge, Los Angeles County 194
- Butte County, mines in—
  - Bay State Drift Mine 28
  - Big Bend Tunnel 273
  - Eureka Drift Mine 28
  - Indian Springs Drift Mines 28
  - Lucretia Drift Mine 28
  - Magalia Drift Mine 28
  - Oro Fino Drift Mine 28
  - Spring Valley Drift Mining Company's property 27

C

- Cable Claim, Los Angeles County 198
- Calaveras County, mine in—
  - Morgan Quartz Claim 37
- Casa Grande Mines, Los Angeles County 195, 196
- Cedar Mining District, Los Angeles County 191
- Cement, California 309–311
- Cement, San Diego County 309
- Cement, analysis of 309
- Calico Mining District, San Bernardino County 224
- California variety and distribution of mineral wealth 19–20
- California cement 309–311
- Calumet Claim, San Bernardino County 226
- Capital Mine, San Bernardino County 229
- Carbonate Mine, San Bernardino County 230, 233
- Cement deposits of California 37
- Cement product of United States, 1888 333
- Cement rock, San Diego County; Jamul Grant 139–140
- Central Camp Mine, San Bernardino County 230
- Chalcedony, Channel Islands 172
- Chalcedony, Santa Cruz Island 158, 159
- Chaney Coal Mine, San Diego County 152
- Channel Islands, mollusca of. By Dr. Lorenzo G. Yates 175–178
- Channel Islands, stray notes on the geology of the. By Dr. Lorenzo G. Yates 171–188
- Charges for coinage at mints 91–92
- Chieftain Mine, San Diego County 145
- Chip's Flat Quartz Claim, Sierra County 38
- Chlorine process for removing silver from gold 87–89
- Chloride of silver, reduction of 70
- Chromite, Santa Clara County 56
- Chromium product of the United States, 1888 331
- Chrysolite, Channel Islands 172
- Cincinnati Bell Mine, San Diego County 147
- Clay, Los Angeles County 195, 207, 208, 210
- Clays. By W. D. Johnston, M.D. 287–308
- Clay, San Diego County 152
- Clay, Santa Clara County 56
- Clean-up, etc., in mining 131
- Cleaveland Mine, San Bernardino County 234
- Clincker Claim, San Bernardino County 229
- Clip Springer Claim, San Bernardino County 229
- Coal product of California 323
- Coal product of United States, 1888 ...... 331, 332
- Coal, Los Angeles County 208
- Coal Mine, San Diego County, Chaney 152
- Coal, Santa Clara County 55
- Cobalt oxide product of United States, 1888 331
- Coinage at mints, charges for 91, 92
- Coinage of precious metals at mints 96–103
- Coining of precious metals, refining and. By Sven Gumbinner 62–104
- Coinage (United States), tabulated statement of 104
- Coke product of United States, 1888 332
- Colemanite, San Bernardino County 225
- Colorado Mine, San Bernardino County 233
- Commercial Claim, San Bernardino County 229
- Cornet Claim, San Bernardino County 229
- Corundum product of United States, 1888 333
- Cost of drift mining 119
- Cooper, Dr. J. G. Value of fossils as indications of important mineral products 284–286
- Copper alloys, treatment of 86
- Copper alloy in United States coins 96

PAGE.

- Copper King Mine, San Bernardino County 233
- Copper, Los Angeles County 195
- Copper mining, San Bernardino County 232
- Copper ore, San Diego County 144
- Copper product of United States, 1888 330
- Copper, San Bernardino County 217, 233
- Copper, Santa Clara County 56
- Copper, United States, 1888 336–337
- Cost of mining and milling ores 25
- Crevicing in California 38
- Crossman, James H. Report on San Bernardino County, California 214–239
- Crystallization of the sulphate of copper solution 78
- Cuticura Mine, San Bernardino County 234

D

- Damascus Channel, longitudinal section of 115
- Dam and Water Company, San Bernardino County; submerged 219
- Damm Channel, cross-section of 116
- Dardanelles Drift Mine, Placer County 29
- Debasing the bullion 20–21
- De Groot, Dr. Henry. Manufacture of glass in California 324–329
- Dick Turpin Mine, San Bernardino County 235, 236
- Dissolving silver 68
- Dissolving silver from gold alloys 69
- Donors to the museum 8–10
- Dredging 38
- Dross and slags, reduction of 85
- Drift operations 27–29
- Drift Mining District, Forest Hill, Placer County. Reference to future report, by Ross E. Browne 45–46
- Dry diggings of California 36
- Drift mining, cost of 119
- Distances, San Diego County, table of 153
- Drifting, river mining by 277
- Dump, etc. 126–128
- Dunn, R. L. River mining 262–281
- Dundee Claim, Los Angeles County 198
- Dutch Hill Drift Mine, Plumas County 28

E

- Eagle Mine, Los Angeles County 196
- Eagle Mine, San Diego County 145
- El Dorado slate 283
- Elevators, deep bar mining by 278
- Emma Consolidated Mining Company, Los Angeles County 194, 195
- Employés of State Mining Bureau 16
- Eureka Drift Mine, Butte County 28
- Evening Star Claim, Los Angeles County 199
- Evening Star Company, Lassen County 212
- Everett Mine, San Bernardino County 231
- Excelsior Mine, Lassen County 212

F

- Falcon centrifugal pump 39
- "Feix" chambers for condensing volatilized metals 66–67
- Feldspar, United States, 1888 334
- Flint, United States, 1888 334
- Flumes and tunnels, permanent. River mining 271
- Fluming 268
- Fluorspar product of United States, 1888 334
- Flynn Stone Quarry, Santa Clara County 54
- Fraction Claim, San Diego County 146
- Fuchsite, Los Angeles County 210
- Fuels of United States 331–332
- Furnaces and vessels used in parting gold and silver 72

G

- General Mine, San Bernardino County 229
- Geological age of the alluvions 108
- Geological reports issued on California 42–43

PAGE.

Geological Survey of California. By H. I. Willey 40–45
Glass in California, manufacture of. By Dr. Henry De Groot 324–329
Glazier Drift Mine, Plumas County 28
Gold and silver alloys, dissolving 69
Gold and silver alloys, granulation of 67–68
Gold and silver by nitric acid, parting 67
Gold and silver by sulphuric acid, parting 71
Gold and silver produced in United States, 1888 336
Gold and silver products of United States, 1888 330
Gold bluffs and beaches of California 35, 36
Gold Bluff, Humboldt County, California 36
Gold Bullion Mine, Los Angeles County 195, 196
Golden Chariot Mine, San Diego County 147
Golden Eagle Claim, Lassen County 212
Golden Gate Alluvial Syndicate (limited), Feather River, California 271
Golden River Drift Mine, Placer County 29
Golden Rule Mine, Los Angeles County 195, 196
Gold, extraction of 118–119
Gold in auriferous gravels, distribution of 112–113
Gold in California, annual output, 1850–55 18
Gold King and Gold Queen Claims, San Diego County 143–144
Gold King Mine, San Bernardino County 226
Gold, loss in mining 131–132
Gold, pressing and drying 69
Gold, purifying 74–76
Gold, purifying of, in refining 68–69
Gold, purifying with sulphuric acid 69
Gold, silver, copper, and lead, aggregate amount of, in Pacific States and Territories 17
Good Hope Mine, San Diego County 151
Goodrich Stone Quarry, Santa Clara County 53–54
Goodyear, W. A. (Geologist and Assistant in Field). Report on San Diego County, California 139–154
Goodyear, W. A. Santa Cruz Island 155–170
Granulation of gold and silver alloys 67–68
Gravel at hydraulic mines, yield of 133
Gravel at important hydraulic claims in California, yield of 134–135
Gravel at smaller hydraulic, drift, and cement claims, yield of 136–137
Gravel deposits, sections of 114
Gravel, depth of 112
Granite quarry, San Diego County 149
Granite quarries, Temecula Cañon, San Diego County 149
Granite, San Bernardino County 224
Graphite product of United States, 1888 334
Gravels of California, auriferous. By John Hays Hammond, E.M. 105–138
Great West Quartz Claim, Los Angeles County 204
Greenwood Valley, El Dorado County, seam diggings 37
Grindstones, product of, United States, 1888 333
Grizzlies and undercurrents 130
Guadaloupe Lime Company, Santa Clara County 52
Guadaloupe Mining Company's property, Santa Clara County 52
Gumbinner, Sven. Refining and coining of precious metals 62–104
Gutzkow process 79–81
Gypsum, Los Angeles County 195
Gypsum, United States, 1888 334

H

Hammond, John Hays, E.M. Auriferous gravels of California 105–138
Harrison Mine, San Bernardino County 233–236
Hecla Claim, San Bernardino County 226
Helvetia Mine, San Diego County 145–146
Hematite, San Diego County 144
Herman Drift Mine, Placer County 29
Hidden Treasure Drift Mine, Placer County 29, 120
Hidden Treasure Mine, San Diego County 147
Homestake Mine, San Bernardino County 230
Hope Claim, Los Angeles County 197
Horseshoe Bar, Placer County 32
Horseshoe Bar River Mine, Placer County 277
Horseshoe Bend, Mariposa County 32
Hydraulic mines, yield of gravel at 133–135
Hydraulic mining 26, 121–122

I

PAGE.

Ibex Mill, San Bernardino County 238
Illustrations—
  American Belleek jug 246
  Arched passage, near eastern end of West Anacapa 174
  Auriferous gravels of Castaca, Palamos, and San Feliciana Cañons, Los Angeles County 201
  Bowman (main) Dam, North Bloomfield Company 122
  Bracket flume and trestle (Miocene Company) 138
  Brush dam, North Bloomfield Company 132
  Channel between Middle and East Anacapas 176
  Cherokee Flat, Butte County 130
  Cross-section Damascus and Bob Lewis Channels 116
  Cross-section Iowa Hill Channel system 116
  Cross-section ridge between North and Middle Forks of American River 116
  Cross-section Red Point and Damm Channels 116
  Cross-section Red Point, Hogs Back, and Black Cañon Channels 116
  Cross-section Secret Hill and Canada Hill Channel 116
  Cross-section timber dam, river mining 269
  Denudation (Los Angeles County), with later redepositing 198
  Diagram of a river channel 264
  Distant view of West Anacapa 180
  Drop for disintegrating gravel 130
  Eastern extremity of Anacapas 178
  Fault in Castaca Cañon, Los Angeles County 203
  Flumes and ditch carried around mountain side 122
  Folding in shale, near Los Angeles City 207
  General Sutter (terra cotta medallion) 299
  Golden Gate Mine, Feather River; dam under construction 272
  Golden Gate Mine, Feather River; dam completed 272
  Gulch washing, etc. 107
  Hobson Mine, Placer County 126
  Hobson's improved undercurrent 130
  Horseshoe Bar Consolidated Mining Company; plan and cross-section of tunnel 276
  Hydraulic elevator, Bloomfield Mine 108
  Hydraulic gravel elevator 279
  Lamp, American art fayence 246
  Largest potted vase 252
  "Liberty" (terra cotta medallion) 300
  Log dam for impounding tailings from an hydraulic mine 132
  Longitudinal section of Damascus Channel and cross-sections of Red Point Channel 116
  Longitudinal section of Iowa Hill Channel system 116
  Mammoth Bar Mine, Middle Fork of American River; mining in pit 280
  Mammoth Bar Mine, Middle Fork of American River, showing working pit, elevator, sluices, etc. 280
  Map of Anacapa Islands 172
  Map of Horseshoe Bar, Placer County 275
  Map of Santa Cruz Island 156
  Method of carrying flumes across cañon by iron arch 130
  Miocene Company's bracket flume 138
  Monitor 126
  Pan and cradle 106
  Pioneers crossing the plains (terra cotta panel) 300
  Piping at the North Bloomfield Mine, Nevada County 122
  Pottery 240
  Pottery, Gladding, McBean & Co. 298
  Pottery, work of Louise M. McLaughlin 248
  Quartz exposure in Bear Cañon, Los Angeles County 200
  Raising the Bear Flag (terra cotta panel) 300
  Section of a cañon near Newhall, Los Angeles County 206
  Sluice line constructed on a curve 128
  Spring Valley Mine, Butte County 124
  Water power derrick for removing heavy bowlders 126
Imperial Mine, San Bernardino County 227
Inch, duty of miner's 125, 126
Indian Springs Drift Mine, Butte County 28
Ingots in the Mint, molding of 93–95
Insular floras, Channel Islands. By Dr. Lorenzo G. Yates 179–188
Iowa Hill Channel system; longitudinal and cross-sections of 116
Irelan, Linna. "Pottery" 240–261
Iron and steel products of the United States for 1888 330
Iron ore, San Diego County 144–154
Iron, San Bernardino County 235
Irrigation, San Bernardino County 219–220

J

PAGE.
Jamul Grant cement rock, San Diego County 139–140
Japanese porcelain stones 305–308
Johnston, W. D. (M.D.). "Clays" 287–308
Josephine Mine, Los Angeles County 197
Julian District, San Diego County 144
Juniper Mine, Lassen County 212
Jupiter Claim, San Bernardino County 234

K

Kaolins; foreign, American, and Californian 302
Kelly Bros.' Mine, Los Angeles County 195, 196
Kelsey Claim, Los Angeles County 208
King Mill, San Bernardino County 238

L

Lady Alice Claim, San Bernardino County 226
Lassen County, California. Report by E. B. Preston, E.M. 211–213
Lassen County, mines and claims in—
    Blue Bell Claim 212
    Brush Hill Claims, Nos. 1 and 2 212
    Evening Star Company's property 212
    Excelsior Mine 212
    Golden Eagle Claim 212
    Juniper Mine 212
    Providence Claim 212
Last Chance Mine, Los Angeles County 196
Lava Bed District, San Bernardino County 230
Lawrence Mine, San Bernardino County 233
Lead product of United States, 1888 ..... 330, 337
Lead, San Bernardino County 217, 233
Library, State Mining Bureau 10
Lime Company, Santa Clara County, Guadaloupe 52
Lillie Claim, San Bernardino County 228
Lime kilns, San Bernardino County 215
Lime product of United States, 1888 332
Lime quarries, San Bernardino County 225
Lime, soft, analysis of 309
Limestone, Los Angeles County 202
Limestone, San Bernardino County 310
Limestone, San Diego County 151
Limestone, Santa Barbara County 310
Limestone, Santa Clara County 52, 53
Limestone, shell, Los Angeles County, analysis of 310
Live Oak Drift Mine, Placer County 29
Log Cabin Mine, Los Angeles County 195, 196
London Claim, Los Angeles County 197
London Ledge, Los Angeles County 195
Los Angeles County, California. Report by E. B. Preston, E.M. 189–210
Los Angeles County, mines and claims in—
    Bullion Claim 195
    Cable Claim 198
    Casa Grande Mines 195, 196
    Dundee Claim 198
    Evening Star Claim 199
    Emma Consolidated Mining Company's property 194
    Eagle Mine 196
    Great West Quartz Claim 204
    Gold Bullion Mine 195, 196
    Golden Rule Mine 195, 196
    Hope Claim 197
    Josephine Mine 197
    Kelsey Claim 208
    Kelly Brothers' Mine 195, 196
    London Claim 195, 197
    Log Cabin Mine 195, 196
    Last Chance Mine 196
    Lottie Claim 197
    Moose Claim 198
    Mint Claim 208
    Mount Gleason Mines 195, 197
    Nevada Gold Mining Company's property 203

PAGE.
    New York Mine 192, 194
    Old Town Mine 195, 196
    Padre Mine 195, 196
    Peerless Mine 195, 196
    Pacific Claim 195, 197
    Red Rover Mine 191, 192
    Star of the East Claim 199
    Star of the West Claim 199
    Silver Mountain Mine 203, 204
    Tujunga Mine 197
    Victoria Gold and Silver Mining Company's property 208
    Veteran Mine 195, 196
Lucretia Drift Mine, Butte County 28

M

Magalia Drift Mine, Butte County 28
Magnesite, Santa Clara County 56
Mammoth Bar Mine, Placer County 280
Mammoth Mine, San Bernardino County 231
Manganese product of United States, 1888 331
Manganese, Santa Clara County 55
Manufacture of glass in California. By Dr. Henry De Groot 324–329
Manzanita Drift Mine, Nevada County 29
Map of California, now in process of construction; topographical 44
Marble, San Bernardino County 214
Marls production of the United States, 1888 333
May Flower Mine, Placer County 29, 120
Melting and preliminary refining of deposited bullion 63–66
Men engaged in mining, number of 21–24
Meissen or Dresden china 243
Mescal Mines, San Bernardino County 217
Metallic products of the United States, 1888 335
Meteor Mine, San Bernardino County 231
Meteorological. By Geo. E. Barnes 312–322
Mica product of United States, 1888 334
Midnight Claim, San Bernardino County 235
Miller's process of refining gold 87–89
Milling ore, cost of mining and 25
Mills and reduction works, San Bernardino County 237–238
Mills, stamps, drops, duty, etc., number of quartz 24–25
Mineral paint product of United States, 1888 334
Mineral products of the United States, 1888 330–339
Minerals of California, economic 24
Minerals of California not heretofore in the museum collection excepting from foreign sources 46–47
Mineralogist, report of State 15
Miner's inch, duty of 125
Mining and milling ore, cost of 25
Mining, hydraulic 26, 121–122
Mining in California, river-bed 29–30
Mining of deep placers, methods of 117–118
Mining, number of men engaged in 21–24
Mint Claim, Los Angeles County 208
Mint, coinage at 96–103
Mints, charges for coinage at 91–92
Mojave River, San Bernardino County 218
Mollie G. Claim, San Diego County 142
Mollusca of Channel Islands of California. By Dr. Lorenzo G. Yates 175–178
Monte Cristo Drift Mine, Plumas County 28
Montmorillonite or "Mineral Soap" in San Diego County 139
Moose Claim, Los Angeles County 198
Morning Star Mine, San Bernardino County 231
Morgan Quartz Claim, Calaveras County 37
Morning Star Drift Mine, Placer County 29
Morongo Mine, San Bernardino County 228, 233
Morongo Mining District, San Bernardino County 222
Mountain Gate Drift Mine, Placer County 29
Mount Gleason Mines, Los Angeles County 195–197
Mount Hope Claim, Lassen County 212
Museum, State Mining Bureau 8
Museum, visitors to 8

N

PAGE.

Natural gas product of United States, 1888 332
Natural gas, Santa Clara County 55
New Alamaden Quicksilver Mines, Santa Clara County 52
Nevada County, mines in—
    Manzanita Drift Mine 29
    San José Drift Mine 29
Nevada County, drift deposits in 29
Nevada Gold Mining Company, Los Angeles County 203
Newspapers free to Mining Bureau 10
New York Mine, Los Angeles County 192–194
Nickel product of United States, 1888 331
Nitrate solution of silver, treatment of, in refining 70
North American Drift Mining Company, Plumas County 28
North Bloomfield Company, details of work at No. 8 Claim 138
North Camp Mine, San Bernardino County 228
Nuggets, formation of 110
Nuggets found in California 38

O

Oil Companies, Pacific and California Star 204–205
Oil in Los Angeles County 205
Oilstones and whetstones, United States 333
Old Dad's Mountain, San Bernardino County 217
Old Woman's Mountain, San Bernardino County 217
Old Town Mine, Los Angeles County 195, 196
Ore, cost of mining and milling 25
Oro Fino Drift Mine, Butte County 28
Oro Grande Mine, San Bernardino County 227
Ord Mines, San Bernardino County 226
Ord Mining District, San Bernardino County 222
Owens Mine, San Diego County 144
Ozocerite, United States, 1888 334

P

Pacific Ledge, Los Angeles County 195
Padre Mine, Los Angeles County 195, 196
Palomar Mountain, San Diego County 148
Parting gold and silver by nitric acid 67
Parting gold and silver by sulphuric acid, methods of 71–76
Parting of Doré bars in refining and coining precious metals 77
Parting silver from gold, methods of 76, 77, 79
Pavements, etc. 129
Peerless Mine, Los Angeles County 195, 196
Petroleum, Santa Clara County 54
Petroleum product of United States, 1888 332
Phosphate rock of United States, 1888 333
Pine Valley Mining District, San Diego County 141–143
Placers of auriferous gravel, shallow or modern 105
Placer County, drift deposits in 29
Placer County, mines in—
    Breece & Wheeler Drift Mine 29
    Baker Divide Drift Mine 29
    Blue Wing Drift Mine 29
    Dardanelles Drift Mine 29
    Golden River Drift Mine 29
    Hidden Treasure Drift Mine 29, 120
    Herman Drift Mine 29
    Horseshoe Bar River Mine 277
    Live Oak Drift Mine 29
    Mayflower Drift Mine 29, 120
    Mountain Gate Drift Mine 29
    Morning Star Drift Mine 29
    Mammoth Bar Mine 280
Platinum product of United States, 1888 331
Plumas County, mines in—
    Bald Mountain Extension Drift Mine 28
    Dutch Hill Drift Mine 28
    Glazier Drift Mine 28
    Monte Cristo Drift Mine 28
    North America Company Drift Mine 28

PAGE.

    Port Wine Drift Mine 28
    South Fork Drift Mine 28
    Sunny South Drift Mine 28
Pocket mining in California 37
Porcelain 240, 241
Porcelain, decoration 253
Porcelain, history of some celebrated 243–247
Porcelain, glazing 252
Porcelain, manufacture of 247
Porcelain, painting and firing 254–257
Porcelain stones, Japanese 305–308
Pontiac Claim, San Bernardino County 228
Port Wine Drift Mine, Plumas County 28
Pottery 293
Pottery. By Linna Irelan 240–261
Pottery, decorative 295
Pottery, origin of 241
Pottery, tables giving kinds of 258–261
Pottery, decoration 253
Pottery, technical terms on 242–243
Potters' clay, United States, 1888 334
Precious metals, refining and coining of. By Sven Gumbinner 62–104
Precious stones of United States, 1888 333
Precipitation of the silver sulphate 75
Precipitation of silver sulphate in refining and coining 77
Pressing and drying gold 69
Preston, E. B., E.M. Report on Lassen County, California 211–213
Preston, E. B., E.M. Report on Los Angeles County, California 189–210
Providence Claim, Lassen County 212
Purifying gold with sulphuric acid 69
Purifying gold 74
Purifying metallic silver 75
Purifying precipitated silver in refining 70
Purifying the gold in parting 68–69
Pyrites, United States, 1888 333

Q

Quarrying in California, slate 282–283
Quartz mills, stamps, drops, duty, etc., number of 24–25
Quicksilver loss 131
Quicksilver, Los Angeles County 209
Quicksilver product of United States, 1888 330
Quicksilver, United States, 1888 337

R

Ready Relief Mine, San Diego County 147
Red Point Channel, cross-section of 115–116
Red Rover Mine, Los Angeles County 191–192
Reduction of sediments in refining 75
Refined metals, melting of 81–85
Refining and coining of precious metals. By Sven Gumbinner 62–104
Refining gold. Miller's process 87–89
Refining of the silver slabs 71
Rincon Mill, San Bernardino County 239
Rising Sun Mine, San Bernardino County 232
River-bed mining in California 29, 30, 31
River mining by dredger, etc. 277
River mining by drifting 277
River mining. By R. L. Dunn 262–281
Rivers, grade of the pliocene 112
Rose Mine, San Bernardino County 226–227

S

San Bernardino County, California. Report by James H. Crossman 214–239
San Bernardino County, mines in—
    Beauregard Mine 234
    Bessemer No. 1 Mine 235
    Bald Mountain Gold Mines 237
    Boss Mine 229
    Blue Jay Mine 230

Page.

    Blue Jacket Mine 230
    Black Hawk Mines 226
    Cornet Claim 229
    Clincker Claim 229
    Commercial Claim 229
    Capital Mine 229
    Central Camp Mine .... [illegible]
    Copper King Mine 233
    Colorado Mine 233
    Calumet Claim 226
    Clip Springer Claim 229
    Carbonate Mine 230, 233
    Cleaveland Mine 234
    Cuticura Mine 234
    Dick Turpin Mine 235, 236
    Everett Mine 231
    General Mine 229
    Gold King Mine 226
    Hecla Claim 226
    Harrison Mine 233, 235, 236
    Imperial Mine 227
    Jupiter Claim 234
    Lady Alice Claim 226
    Lawrence Mine 233
    Lillie Claim 228
    Mammoth Mine 231
    Meteor Mine 231
    Morning Star Mine 231
    Midnight Mine 235
    Morongo Mine 228, 233
    North Camp Mine 228
    Ord Mines 226
    Oro Grande Mine 227
    Pontiac Claim 228
    Rising Sun Mine 232
    Rose Mine 226–227
    Stranger Claim 229
    Short & Ross Mine 226
    Santa Fe Claim 226
    Side Issue Claim 229
    Side Winder Mine 227
    Sparkhule Mine 227
    Silver Belt Mine 228
    Silver Belt Claim 233
    Stonewall Jackson Mine 234
    Scorpion Mine 236
    San Gabriel Gold Mine 237
    Twenty-nine Claim 229
    Tip-Top Mine 231
    Tip-Top Claim 235, 236
    Ventura Claim 234
    West Camp Mine 229
    Whatnot Mine 228
San Diego County, California. Report by W. A. Goodyear 139–154
San Diego County cement 309
San Diego County, mines in—
    Acme Claim 142
    Bay View Claim 142
    Big Blue Claim 146
    Chieftain Mine 145
    Chaney Coal Mine 152
    Cincinnati Bell Mine 147
    Eagle Mine 145
    Fraction Claim 146
    Gold King Claims 143, 144
    Gold Queen Claims 143, 144
    Good Hope Mine 151
    Golden Chariot Mine 147
    Helvetia Mine 145, 146
    Hidden Treasure Mine 147
    Mollie G. Claim 142
    Owens Mine 144
    Ready Relief Mine 147
    Stonewall Mine 143

Page.

    San Diego Mine 146
    Wilcox Claim 142
    Washington Mine 145
San Diego County, table of distances 153
Sandstone, Los Angeles County 195
Sandstone, San Bernardino County 225
Sandstone, Santa Rosa Island 172
Santa Clara County, California; report on. By A. H. Weber 48–56
Santa Clara County, mine in—
    New Almaden Quicksilver Mine 52
Santa Cruz Island. By W. A. Goodyear 155–170
Santa Cruz Island. By Dr. Lorenzo G. Yates 171
Santa Rosa Island 155
San Gabriel Gold Mine, San Bernardino County 237
San José Drift Mine, Nevada County 29
San Miguel Island 155
San Nicolas Island, Ventura County. By Dr. Stephen Bowers 57–61
Santa Fe Claim, San Bernardino County 226
Scorpion Mine, San Bernardino County 236
Seam diggings of California 37
Secret Hill and Canada Hill Channels, cross-section of 115
Shasta County, mine in—
    Baughart Mine 38
Shearer Quarry, San Bernardino County 224
Short & Ross Mine, San Bernardino County 226
Side Issue Claim, San Bernardino County 229
Side Winder Mine, San Bernardino County 227
Sierra County, mines in—
    Bald Mountain Mine 120
    Chip's Flat Quartz Claim 38
Silver and gold, Santa Clara County 55
Silver and its effects on California, the future of 32–35
Silver Belt Mine, San Bernardino County 228, 233
Silver, dissolving of, in refining 68
Silver from gold, methods of parting 76, 77, 79
Silver from gold, process for removing 87–89
Silver, purifying, in refining 70
Silver, purifying metallic 75
Silver, solution of 73
Silver mining, San Bernardino County 228
Silver Mountain Mine, Los Angeles County 203, 204
Silver slabs, refining of 71
Silver sulphate, precipitation of 75
Slate quarrying in California 282–283
Sluices, grade, etc. 128–129
Soap in San Diego County 139
Soap (mineral) in San Diego County (montmorillonite) 139
Soapstone, United States, 1888 334
South Fork Drift Mine, Plumas County 28
Sparkhule Mine, San Bernardino County 227
Specimens, facilities for receiving 8
Springs, San Bernardino County Warm 221
Springs, San Diego County, Buckman's 140
Springs, San Diego County, Warner's Valley Hot 140
Spring Valley Company, Butte County 27
Spring Valley Drift Mining Company, Butte County 27
Stamps, drops, duty, etc.; number of quartz mills 24, 25
Stanford Stone Quarry, Santa Clara County 54
Star of the East Claim, Los Angeles County 199
Star of the West Claim, Los Angeles County 199
State Mining Bureau Trustees' report 5
St. Johns' Granite Quarry, San Bernardino County 225
Stonewall Jackson Mine, San Bernardino County 234
Stonewall Mine, San Diego County 143
Stranger Claim, San Bernardino County 229
Structural materials of the United States, 1888 332
Submerged Dam and Water Company, San Bernardino County 219
Sulphate of copper, crystallization of 78
Sulphurets, value and percentage of 25
Sulphuric acid, parting gold and silver by 71
Sulphur, United States, 1888 333
Sunny South Drift Mine, Plumas County 28
Survey of California, report on Geological. By H. I. Willey 40–45

T

PAGE.

Tables of pastes (kinds of pottery) 258–261
Tabulated statement of United States coinage 104
Tailings 132
Talc, San Diego County 149
Temecula Creek, San Diego County 148
Terra cotta 240
Terra cotta, San Diego County 151–152
Tip-Top Claim, San Bernardino County 235, 236
Tip-Top Mine, San Bernardino County 231
Topographical map of California, now in process of construction 44
Trojan Mining District, San Bernardino County 222
Trustees' report, State Mining Bureau 5
Tujunga Claim, Los Angeles County 197
Tujunga Mining District, Los Angeles County 197
Tunnel, Big Bend, Butte County 30–31
Tuolumne County, mine in—
    Bonanza Claim 37
Twenty-nine Claim, San Bernardino County 229

V

Value of fossils as indications of important mineral products. By Dr. J. G. Cooper 284–286
Ventura Claim, San Bernardino County 234
Veteran Mine, Los Angeles County 195–196
Victoria Gold and Silver Mining and Milling Company, Los Angeles County 208
Volcanic phenomena, San Bernardino County 220–221

W

Wages paid to miners 133
Wages paid underground miners in California 24
Warner's Valley Hot Springs, San Diego County 148
Washington Mine, San Diego County 145
Waterloo Mill, San Bernardino County 238
Waterman Mill, San Bernardino County 238
Water, measurement of 122
Water supply in hydraulicking 122–125
Weber, A. H. Report on Santa Clara County, California 48–56
West Camp Mine, San Bernardino County 229
Whatnot Mine, San Bernardino County 228
Wilcox Claim, San Diego County 142
Willey, Harry I. Report on the Geological Survey of California 40–45
Wingdams, river mining 266

Y

Yates, Dr. Lorenzo G. Stray notes on the geology of the Channel Islands 171–174
Yates, Dr. Lorenzo G. The mollusca of the Channel Islands 175–178
Yates, Dr. Lorenzo G. Insular Floras, Channel Islands 179–188
Yield of gravel 133–137

Z

Zinc product of United States, 1888 330
Zinc, San Bernardino County 236
Zircon product of United States, 1888 334